

# Fujifilm Dimatix DMP2831

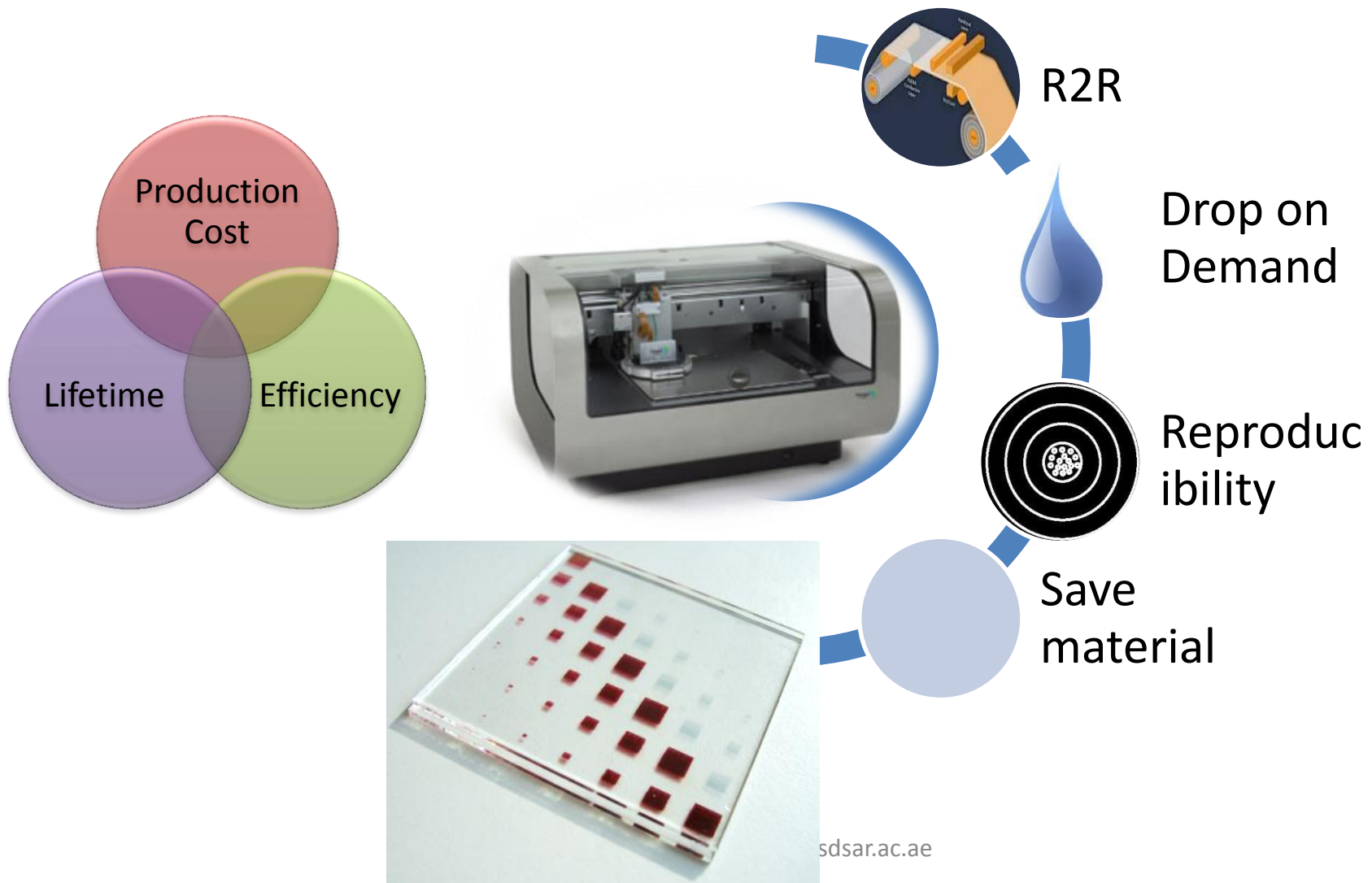
# Summary

- Part 1, Introduction to inkjet printed devices;
- Part 2, How to use the DMP2831;
- Part 3, DMP2831 advanced controls.

# Part 1 - Introduction to inkjet printed devices

- **Why inkjet printing for the fabrication of organic electronic devices?**
- Examples;
- General description of Fujifilm DMP2831;
- Printing a Pattern with the DMP2831.

# Why inkjet printing for the fabrication of organic electronic devices?

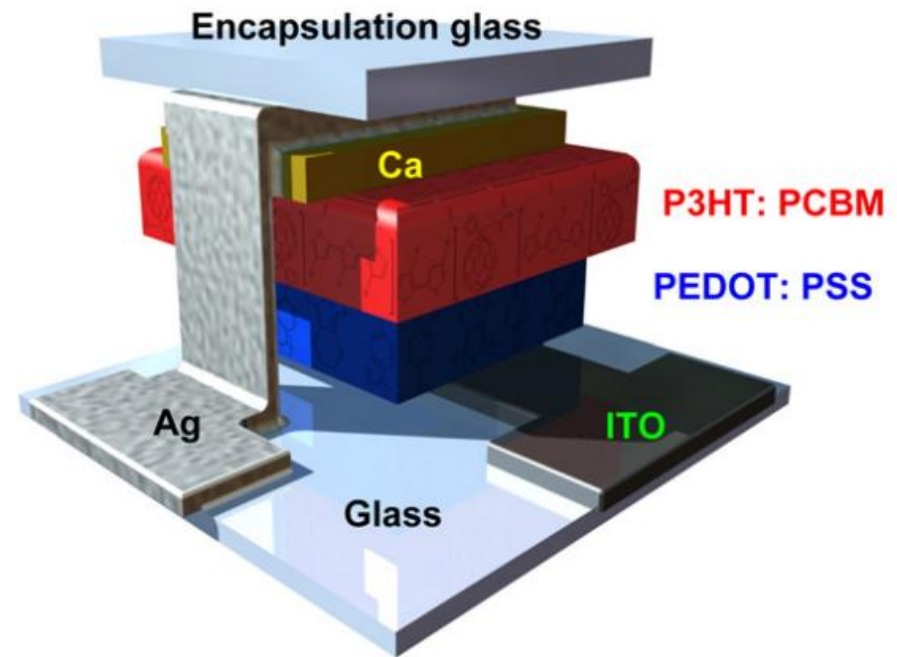


# Part 1 - Introduction to inkjet printed devices

- Why inkjet printing for the fabrication of organic electronic devices?
- **Examples;**
- General description of Fujifilm DMP2831;
- Printing a Pattern with the DMP2831.

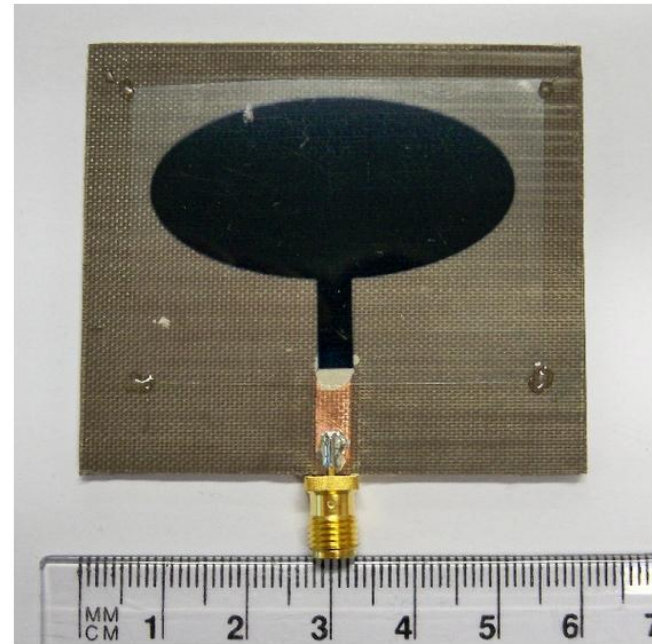
# Example 1: Organic Photodiodes

- *Inkjet Printed Organic Photodiodes* [1]
- Focus on:
  - Inks optimization;
  - DMP2831;
  - Device fabrication.
- Inks:
  - PEDOT: PSS;
  - P3HT: PCBM.



## Example 2: UWB Antenna

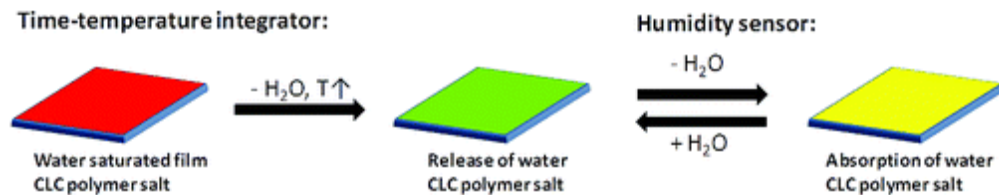
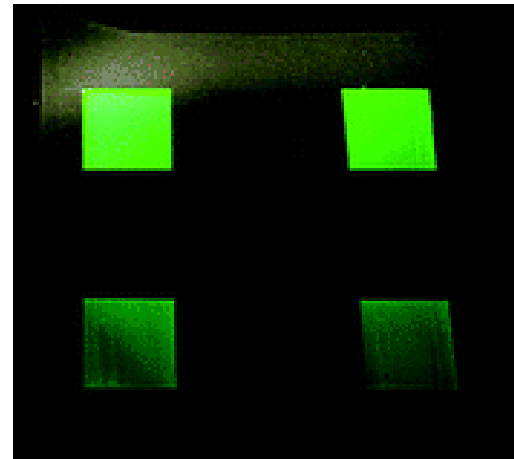
- *Efficiency of a Compact Elliptical Planar Ultra-Wideband Antenna Based on Conductive Polymers [1]*
- Inks:
  - PEDOT;
  - Polypyrrole (Ppy).



[1] Kaufmann, T. *et al.* Efficiency of a compact elliptical planar ultra-wideband antenna based on conductive polymers. *International Journal of Antennas and Propagation* **2012**, (2012).

# Example 3: Optical Humidity Sensor

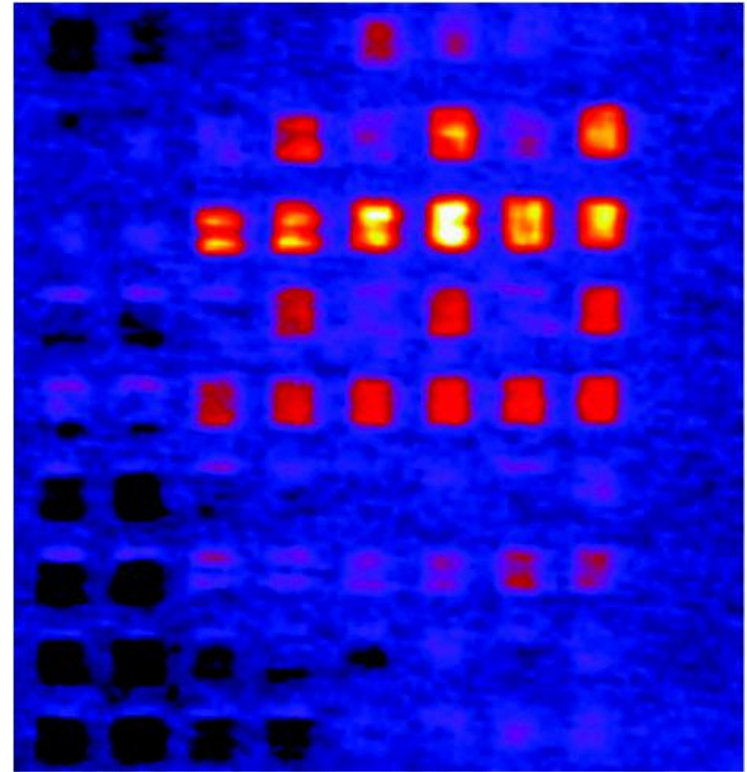
- *Printable Optical Sensors Based on H-Bonded Supramolecular Cholesteric Liquid Crystal Networks* [1];
- Ink: H-bonded CLC materials;
- Relative humidity range detection 3-83%



[1] Herzer, N. *et al.* Printable Optical Sensors Based on H-Bonded Supramolecular Cholesteric Liquid Crystal Networks. *J. Am. Chem. Soc.* **134**, 7608-7611, (2012).

# Example 4: H production from H<sub>2</sub>O

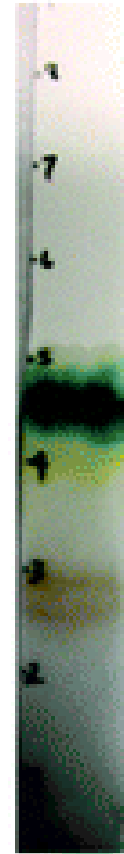
- *Combinatorial Discovery and Optimization of a Complex Oxide with Water Photoelectrolysis Activity* [1];
- Inks: 500 combinations of  $\text{Co}_{3-x-y}\text{Al}_x\text{Fe}_y\text{O}_4$ .



[1] Woodhouse, M. *et al.* Combinatorial Discovery and Optimization of a Complex Oxide with Water Photoelectrolysis Activity. *Chem. Mater.* **20**, 2495-2502, (2008).

# Example 5: Pesticides Detection

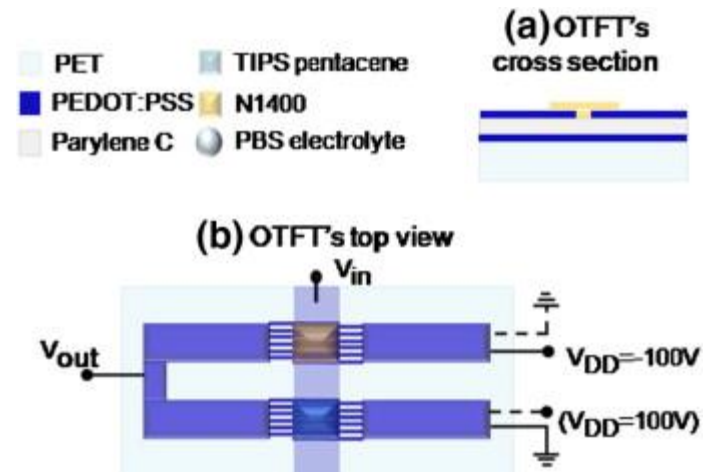
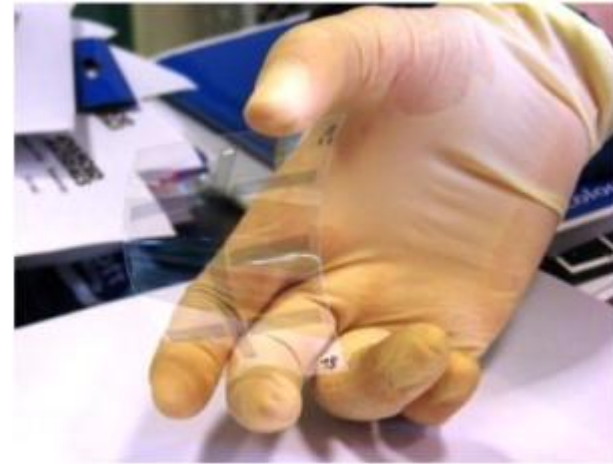
- *Reagentless Bidirectional Lateral Flow Bioactive Paper Sensors for Detection of Pesticides in Beverage and Food Samples [1];*



[1] Hossain, S. M. Z. *et al.* Reagentless Bidirectional Lateral Flow Bioactive Paper Sensors for Detection of Pesticides in Beverage and Food Samples. *Anal. Chem.* **81**, 9055-9064, (2009).

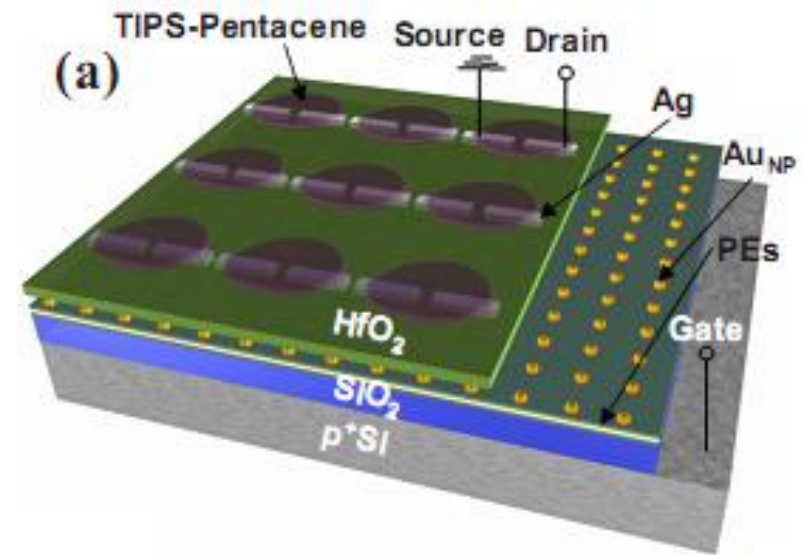
# Example 6: Transparent/Flexible OFET

- *Inkjet printing of transparent, flexible, organic transistors Inks* [1];
- Inks:
  - PEDOT: PSS (electrodes);
  - Pentacene (p-type);
  - N1400 (n-type);



# Example 7: OFET non-volatile Memory

- *High-performance organic charge trap flash memory devices based on ink-jet printed 6,13-bis(triisopropylsilylethynyl) pentacene transistors [1];*
- Inks:
  - Colloidal gold nanoparticles;
  - Polymers (PAH/PSS/PAH);
  - Low temperature curable silver ink.



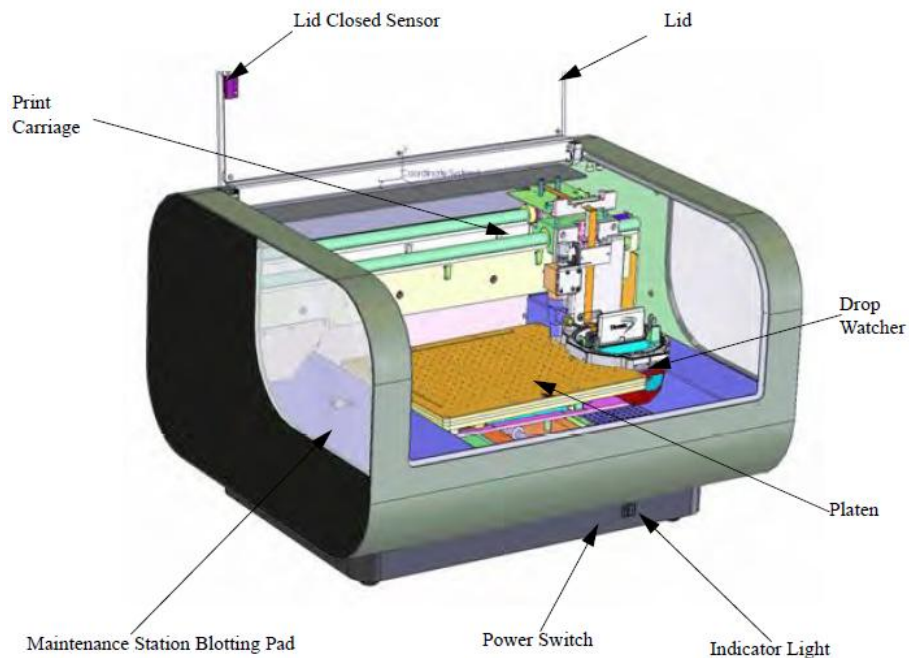
# Part 1 - Introduction to inkjet printed devices

- Why inkjet printing for the fabrication of organic electronic devices?
- Examples;
- **General description of Fujifilm DMP2831;**
- Printing a Pattern with the DMP2831.

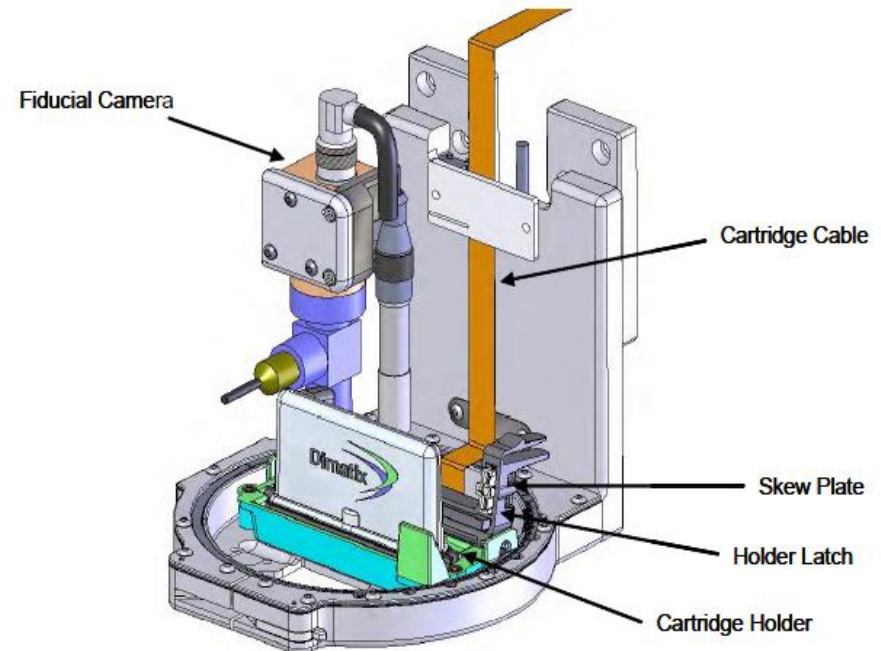
# General description of Fujifilm DMP2831

- DMP is a laboratory production tool for evaluating the use of ink jetting technology for new manufacturing and analytical processes;
- Its resolution depends on the ink and on cartridge properties (about 20um) [1].

## Major components of the DMP



## The DMP Printer Carriage



# Part 1 - Introduction to inkjet printed devices

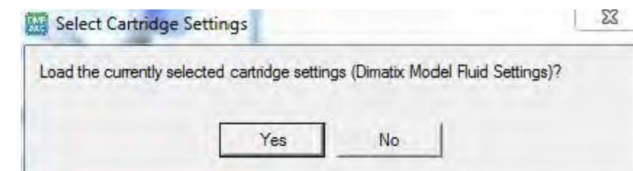
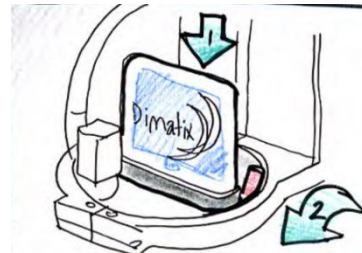
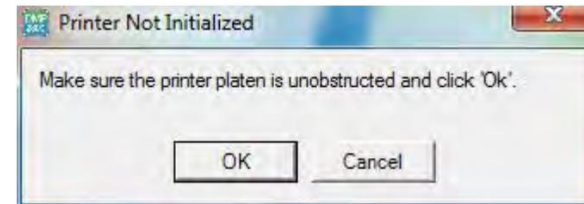
- Why inkjet printing for the fabrication of organic electronic devices?
- Examples;
- General description of Fujifilm DMP2831;
- **Printing a Pattern with the DMP2831.**

# Printing a Pattern (basic steps)

- Start the DMP;
- Open the DMP Drop Manager;
- Make sure the platen is unobstructed;
- Install the Cartridge;

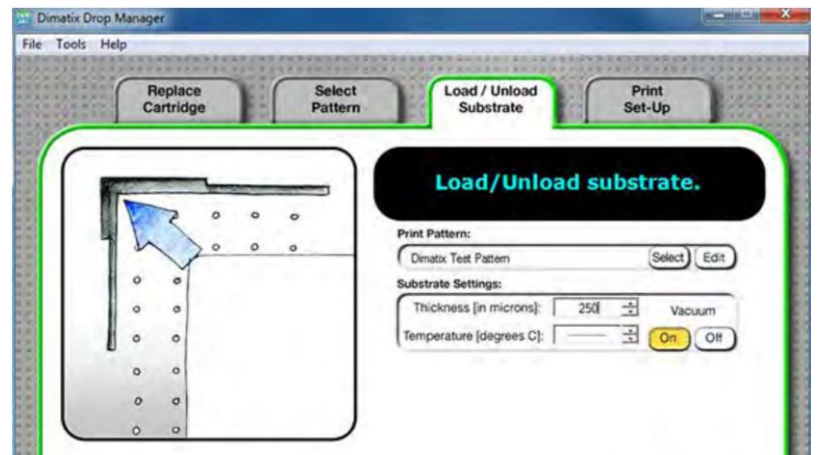
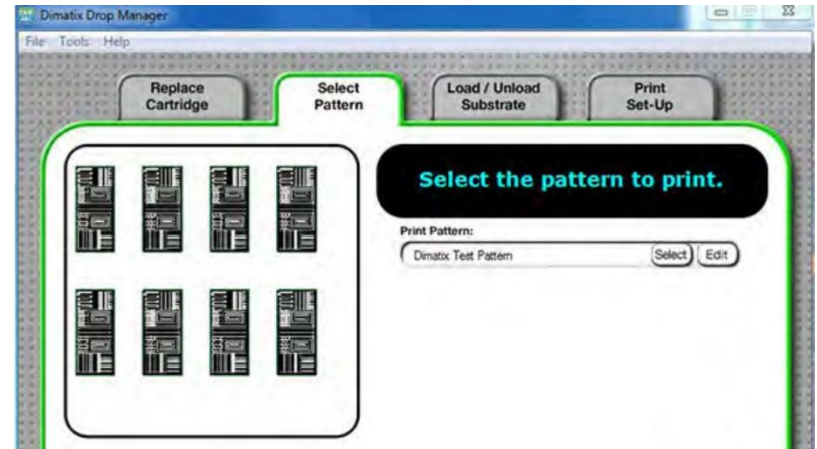


**Dimatix Drop Manager**



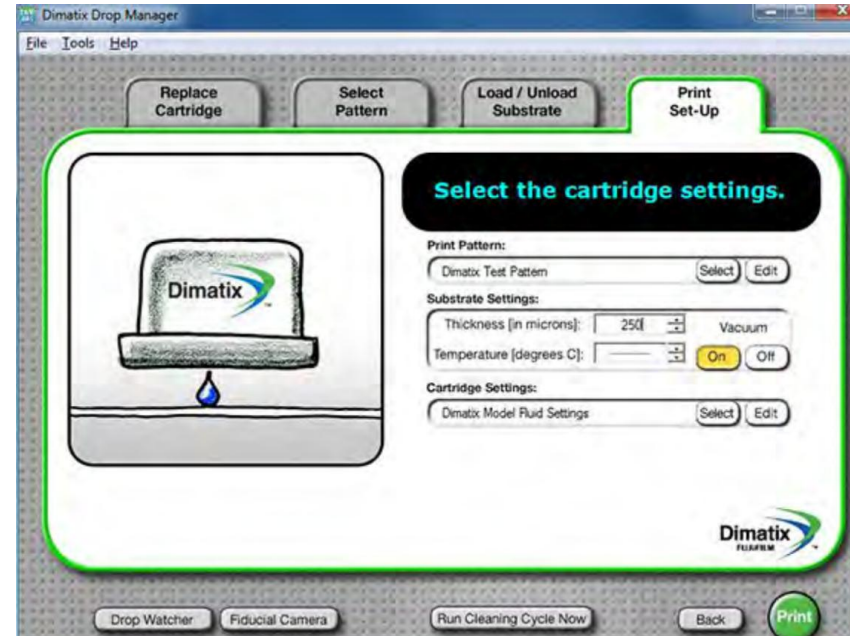
# Printing a Pattern (basic steps)

- Start the DMP;
- Open the DMP Drop Manager;
- Make sure the platen is unobstructed;
- Install the Cartridge;
- Replace the cleaning pad;
- Select Pattern to Print;
- Load/Unload Substrate;
  - Make sure you select the right substrate thickness;
- Vacuum
  - Cover the holes on the platen.



# Printing a Pattern (basic steps)

- Start the DMP;
- Open the DMP Drop Manager;
- Make sure the platen is unobstructed;
- Install the Cartridge;
- Select Pattern to Print;
- Load/Unload Substrate;
  - Make sure you select the right thickness;
- Vacuum
  - Cover the holes on the platen.
- Select Cartridge Settings;
- Print.



# Part 2 - How to use the DMP2831

- Compatible inks;
- Filling and installing the cartridge;
- How to unclog nozzles;
- Install the cartridge;
- Cartridge mounting angle;
- Calibrate the nozzles view;
- The Drop Watcher;
- Designing a Waveform:
  - Waveform shape;
  - Velocities.

# Part 2 - How to use the DMP2831

- **Compatible inks;**
- Filling and installing the cartridge;
- How to unclog nozzles;
- Install the cartridge;
- Cartridge mounting angle;
- Calibrate the nozzles view;
- The Drop Watcher;
- Designing a Waveform:
  - Waveform shape;
  - Velocities.

# Compatible Inks

- **Viscosity** – 10-12 centipoise at jetting temperature;
- **Surface Tension** – 28-33 dynes at jetting temperature (1 dyne =  $10^{-5}$  N);
- **Low Volatility** – Boiling points higher than 100 deg. C are preferred;
- **Density** – Specific gravity greater than 1 is beneficial;
- **Degassing** – Additionally the fluid may need to be degassed to remove any dissolved gas which inhibits jetting. Typical degassing can be done by using ultrasonic;
- **Filtration** – If particle size allows, it is recommended to filter all fluids to 0.2 $\mu$ m.

# Compatible Inks

<b>Conductive Silvers</b>		
DGH 55LT-25C	ANP	<a href="http://www.anapro.com">www.anapro.com</a>
DGH 55HTG	ANP	<a href="http://www.anapro.com">www.anapro.com</a>
DGP 40LT-15C	ANP	<a href="http://www.anapro.com">www.anapro.com</a>
DGP 40LT-45HTG	ANP	<a href="http://www.anapro.com">www.anapro.com</a>
DGP 40TE-20C	ANP	<a href="http://www.anapro.com">www.anapro.com</a>
ANI Nanoparticle Silver Ink	Applied Nanotech	<a href="http://www.nano-proprietary.com">www.nano-proprietary.com</a>
BAYINK Silver Nanoparticle Ink	Bayer MaterialScience	<a href="http://www.bayermaterialscience.com">http://www.bayermaterialscience.com</a>
BAYINK TP S HS	Bayer MaterialScience	<a href="http://www.bayermaterialscience.com">http://www.bayermaterialscience.com</a>
Ag Ink Jet Ink, IJ242-54	Cima Nanotech	<a href="http://www.cimananotech.com">www.cimananotech.com</a>
ALPHA nAg-301J	Cookson Electronics	<a href="http://www.cooksonelectronics.com">www.cooksonelectronics.com</a>
NPJS-J	Harima Electronic Materials	<a href="http://www.harima.co.jp">www.harima.co.jp</a>
NPJS-HTB	Harima Electronic Materials	<a href="http://www.harima.co.jp">www.harima.co.jp</a>
IJ-010	InkTec	<a href="http://www.inktec.com">www.inktec.com</a>
IJ-020	InkTec	<a href="http://www.inktec.com">www.inktec.com</a>
IJ-030	InkTec	<a href="http://www.inktec.com">www.inktec.com</a>
IJ-040	InkTec	<a href="http://www.inktec.com">www.inktec.com</a>
IJ-050	InkTec	<a href="http://www.inktec.com">www.inktec.com</a>
9101 Inkjet silver	Methode Development Corporation	<a href="http://www.methodedevelopment.com">www.methodedevelopment.com</a>
NanoSilver conductive ink	NanoMas Technologies	<a href="http://www.nanomastech.com">www.nanomastech.com</a>
SunTronic Jettable Silver U5603	SunJet	<a href="http://www.sunjetink.com">www.sunjetink.com</a>
SunTronic Jettable Silver U5714	SunJet	<a href="http://www.sunjetink.com">www.sunjetink.com</a>
Silver	Sigma Aldrich	
<b>Conductive Inorganics (not silver)</b>		
ANI Nanoparticle Nickel Ink	Applied Nanotech	<a href="http://www.nano-proprietary.com">www.nano-proprietary.com</a>
ANI Nanoparticle Copper Ink	Applied Nanotech	<a href="http://www.nano-proprietary.com">www.nano-proprietary.com</a>
Intrinsig Materials Nickel Ink Ni-001 Ink	intrinsig materials	<a href="http://www.intrinsigmaterials.com">www.intrinsigmaterials.com</a>
Intrinsig Materials Copper Inks C-001 and C-002	intrinsig materials	<a href="http://www.intrinsigmaterials.com">www.intrinsigmaterials.com</a>
ITO	Air Products	<a href="http://www.airproducts.com">www.airproducts.com</a>
NPG-J (gold)	Harima Electronic Materials	<a href="http://www.harima.co.jp">www.harima.co.jp</a>
NMTI NanoGold Inks (NTG05)	NanoMas Technologies	<a href="http://www.nanomastech.com">www.nanomastech.com</a>
<b>Conductive Organic Materials</b>		
Orgacon PEDOT	AGFA	<a href="http://www.agfa.com">www.agfa.com</a>
CLEVIOS™ P Jet (OLED)	H.C.Starck	<a href="http://www.clevios.com/">www.clevios.com/</a>
OLED	Merck	<a href="http://www.merck-oled.de">www.merck-oled.de</a>
CNTs	Brewer Science	

# Compatible Inks

## SunTronic Solsys Jettable Silver EMD5714 & EMD5603

Property	EMD5714	EMD5603
Silver Content wt%	40	20
Viscosity cps @ 25°C	10 - 13	
Surface Tension (dynes/cm)	27 - 31	
Volume resistivity	5 – 30 $\mu \Omega$ cm @ 150-300 °C	

SunTronic Solsys Jettable Silver can be jetted through various piezo DOD inkjet printheads, although full printhead compatibility will need to be verified in each case. The printed film can be heated under a variety of conditions according to substrate and end-use requirements e.g. a 4 $\mu$ m film printed on Kapton gives a resistance of 8 $\mu\Omega$  cm when heated at 200°C for 30 minutes. SunTronic Jettable Silver has compatibility (adhesion to): various substrates such as Kapton, FR4, glass and metals. Compatible flush SunTronic EMD0500 should be used as a head flush with the silver products.

# Part 2 - How to use the DMP2831

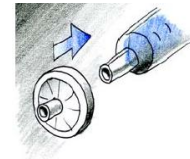
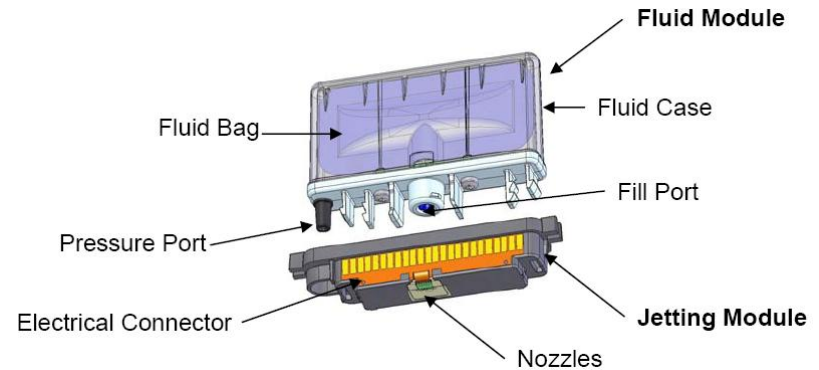
- Compatible inks;
- **Filling and installing a cartridge;**
- How to unclog nozzles;
- Install the cartridge;
- Cartridge mounting angle;
- Calibrate the nozzles view;
- The Drop Watcher;
- Designing a Waveform:
  - Waveform shape;
  - Velocities.

# Part 2 - How to use the DMP2831

- Compatible inks;
- **Filling and installing a cartridge;**
- How to unclog nozzles;
- Install the cartridge;
- Cartridge mounting angle;
- Calibrate the nozzles view;
- The Drop Watcher;
- Designing a Waveform:
  - Waveform shape;
  - Velocities.

# Filling and Installing a Cartridge with the Test Ink

- Shake/sonicate well the ink container;
- Fill the syringe with 2-4ml (you'll lose ink with the filter) of ink;
- Connect filter (if filtering is required);
- Connect special syringe;
- Get rid of the air in the syringe (avoid air bubbles);
- Throw away the first 2 drops;
- Carefully insert the needle into the Fill Port;
- Make sure there is a fluid bubble at the Fill Port. Get rid of air bubbles;
- Install the Jetting Module;
- Let the cartridge rest for 30min with the nozzles facing down (make sure the print head is always facing down);
- Make sure the channel connecting the Fill Port to the Fluid Bag is completely filled with fluid before printing.



# Part 2 - How to use the DMP2831

- Compatible inks;
- Filling and installing a cartridge;
- **How to unclog nozzles;**
- Install the cartridge;
- Cartridge mounting angle;
- Calibrate the nozzles view;
- The Drop Watcher;
- Designing a Waveform:
  - Waveform shape;
  - Velocities.

# How to unclog nozzles

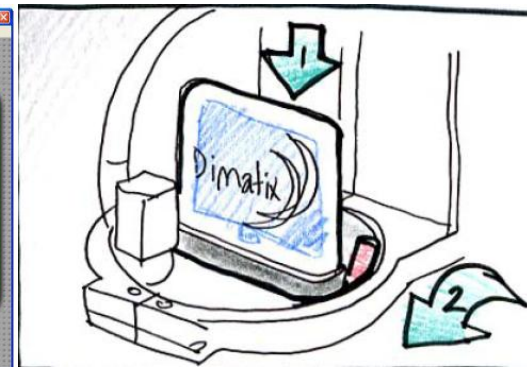
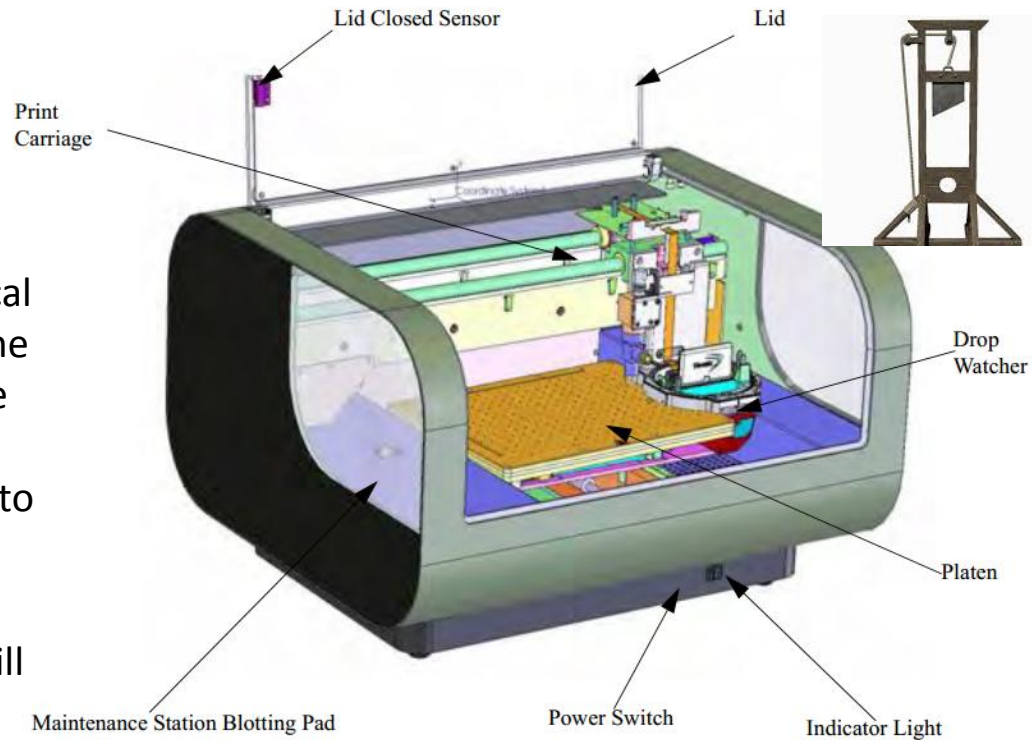
- Use a large beaker;
- Fill it with a thin layer of the same solvent used for the ink inside the cartridge;
- Put the nozzles in contact with the liquid, without touching the bottom of the beaker;
- Push the cartridge up:
  - Nozzles should unclog as an effect of the capillary forces between the nozzles and the liquid.

# Part 2 - How to use the DMP2831

- Compatible inks;
- Filling and installing a cartridge;
- How to unclog nozzles;
- **Install the cartridge;**
- Cartridge mounting angle;
- Calibrate the nozzles view;
- The Drop Watcher;
- Designing a Waveform:
  - Waveform shape;
  - Velocities.

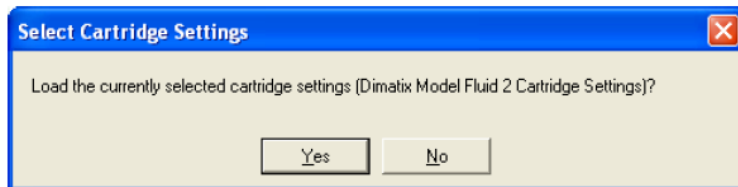
# Install the Cartridge

- **Open the DMP lid**
  - WARNING
- **Insert the cartridge into the cartridge holder** on the carriage with the electrical connection pads towards the back of the machine matching the connector of the holder. There is only one way it will fit. Push it down firmly so that it “clicks” into place.
- **Pull the cartridge holder latch forward and down until it locks in place.** You will hear a click. Check to see that the cartridge is sitting flat in the holder.

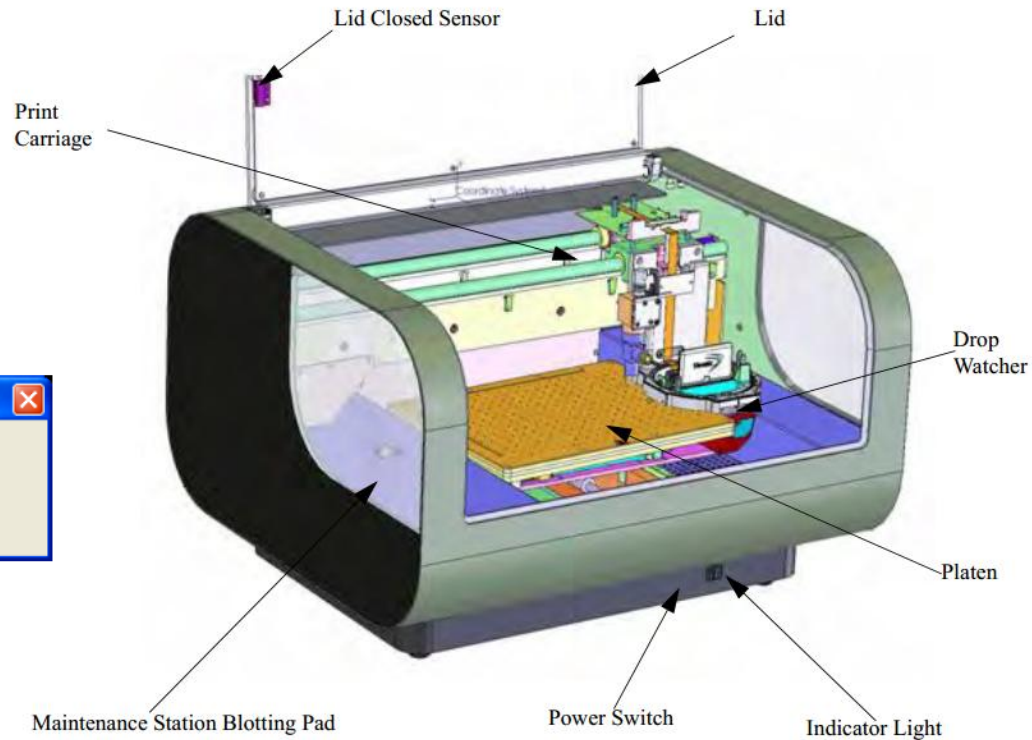


# Install the Cartridge

- After the cartridge is installed, close the lid. **You should hear a pump turn on** to control the meniscus pressure.
- The following window will pop-up.



- Load the Cartridge Setting of the fluid that you will use or, if your fluid has not a Cartridge Setting, simply select the Dimatix Model Fluid 2 Cartridge Setting as a starting point .

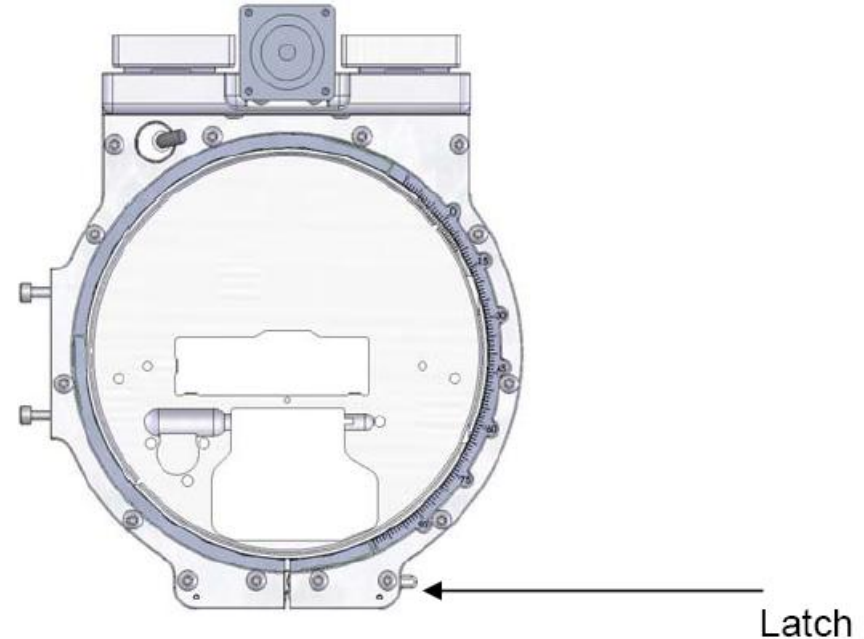


# Part 2 - How to use the DMP2831

- Compatible inks;
- Filling and installing a cartridge;
- How to unclog nozzles;
- Install the cartridge;
- **Cartridge mounting angle;**
- Calibrate the nozzles view;
- The Drop Watcher;
- Designing a Waveform:
  - Waveform shape;
  - Velocities.

# Cartridge Mounting Angle

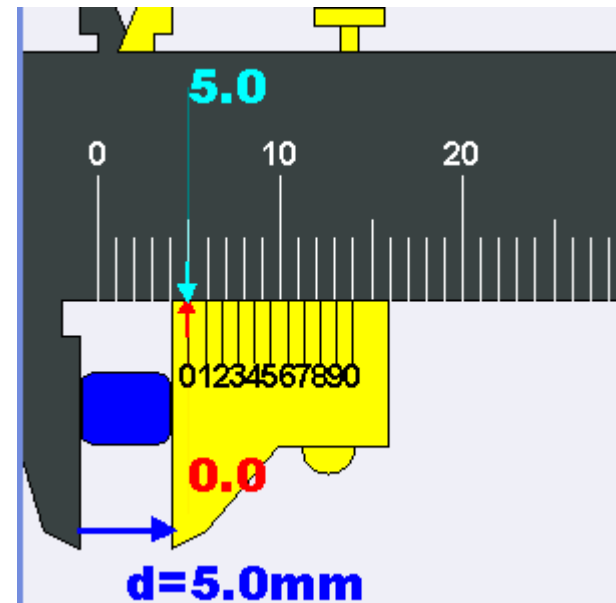
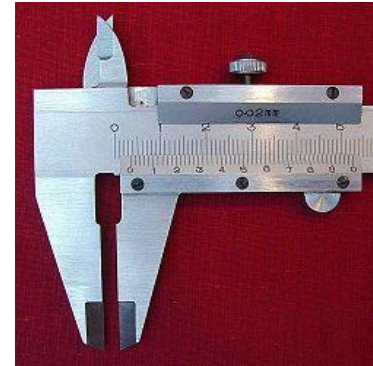
- Before you jet your pattern, the system will calculate the angle to set the cartridge determined by the Grid Spacing specified in the pattern. This angle adjustment is what allows the user to modify the drop spacing in the Y axis.
- There are two sets of scales on the cartridge carriage. The outer scale is the cartridge angle scale, and the inner scale is the **Vernier Scale** to adjust the head angle to 0.1 degree increments. Release the latch by pulling it forward freeing the carriage plate to rotate.



# Cartridge Mounting Angle

## The Vernier Scale

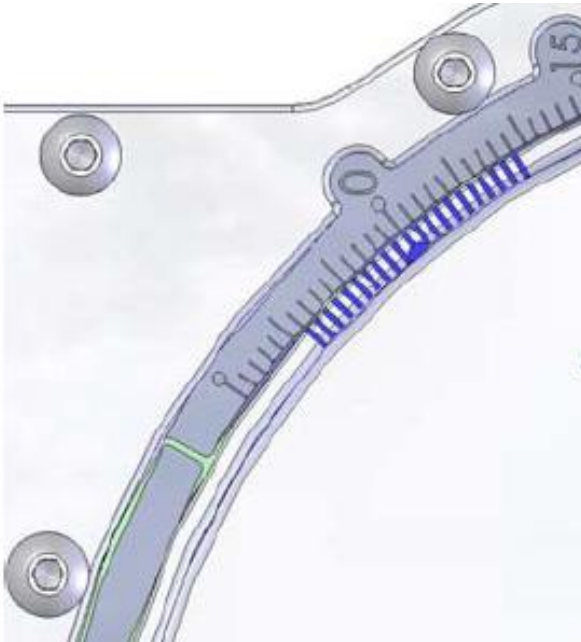
- Uses a Vernier Scale such as the one on the caliper;
- A **Vernier Scale** is an additional scale on a measuring device that lets the user read distance or angle measurement more accurately than could be done by reading a uniformly-divided straight or circular measurement scale.
- It is a sliding secondary scale that indicates where the measurement lies in between two of the marks on the main scale.



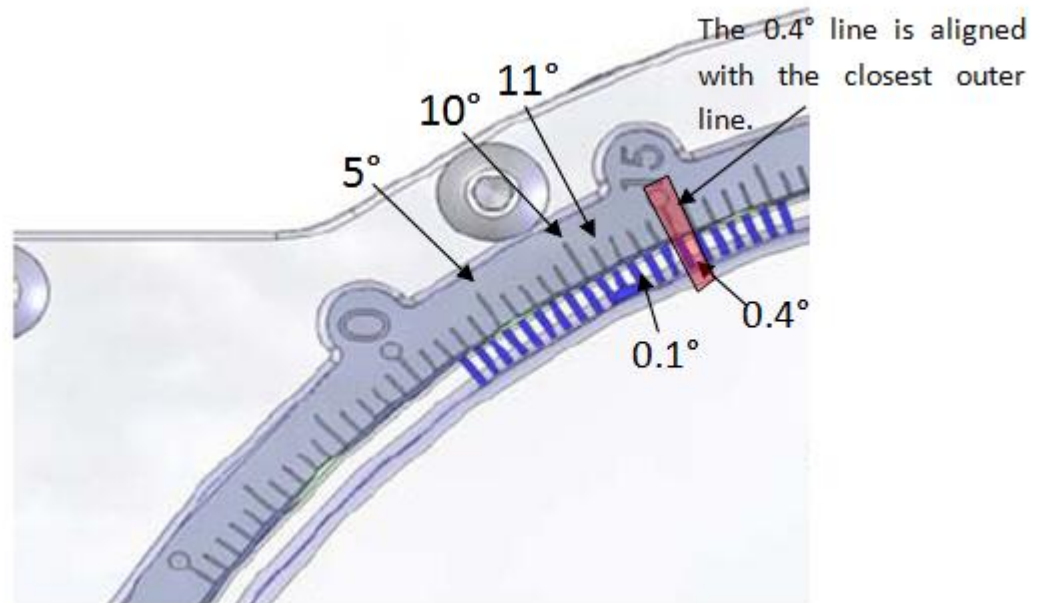
# Cartridge Mounting Angle

## The Vernier Scale

**Zero Degrees**



**11.4 Degrees**

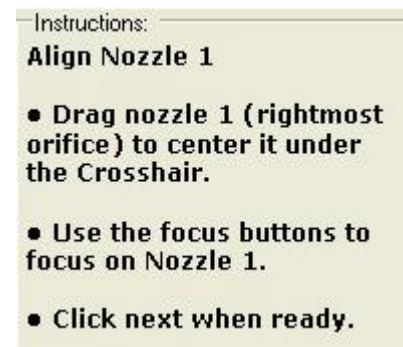
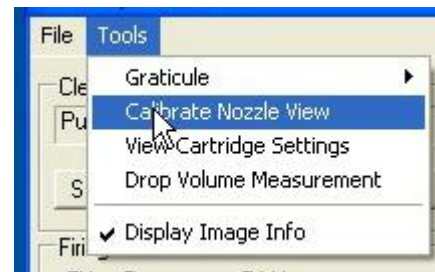
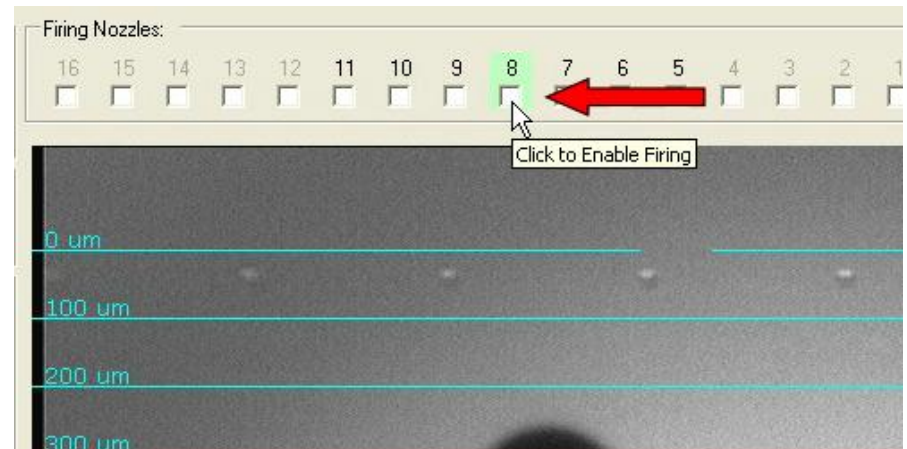


# Part 2 - How to use the DMP2831

- Compatible inks;
- Filling and installing a cartridge;
- How to unclog nozzles;
- Install the cartridge;
- Cartridge mounting angle;
- **Calibrate the nozzles view;**
- The Drop Watcher;
- Designing a Waveform:
  - Waveform shape;
  - Velocities.

# Calibrate Nozzles View

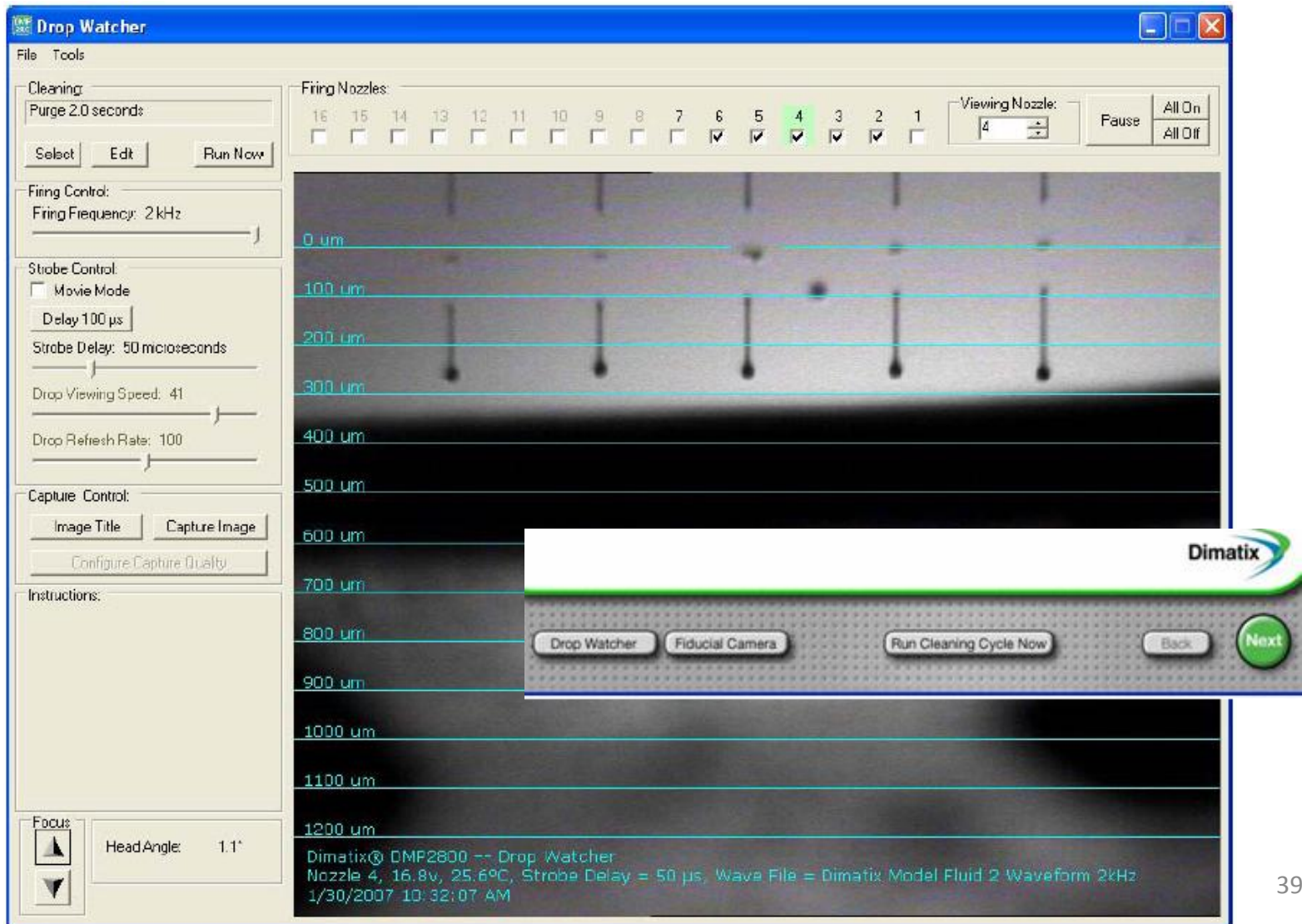
- Calibrate the nozzles to the scale in the Drop Watcher;
- The system doesn't know where the nozzles are, and this step should be performed after a new cartridge is installed;
- Right click on a reference nozzle (e.g. 8)
- Tools -> Calibrate Nozzle View
- Follow the instructions in the Instructions panel.
- If you cannot identify the nozzle, activate it, and play with the strobe delay.



# Part 2 - How to use the DMP2831

- Compatible inks;
- Filling and installing a cartridge;
- How to unclog nozzles;
- Install the cartridge;
- Cartridge mounting angle;
- Calibrate the nozzles view;
- **The Drop Watcher;**
- Designing a Waveform:
  - Waveform shape;
  - Velocities.

# The Drop Watcher (DW)



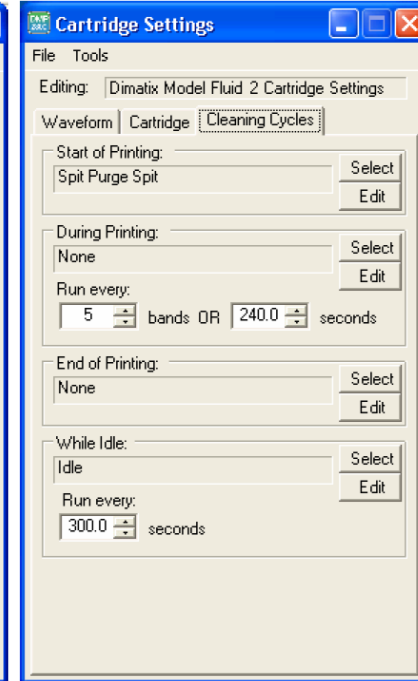
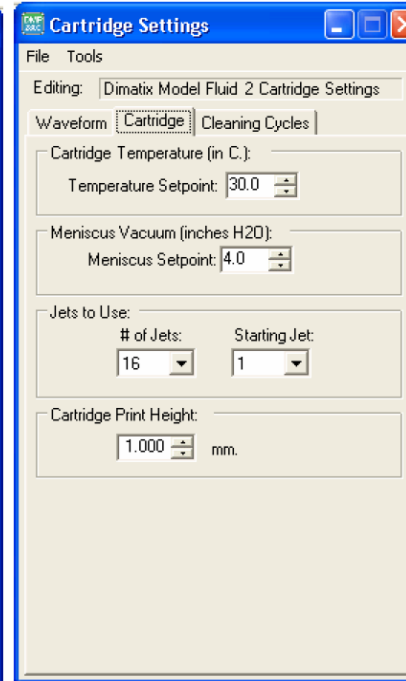
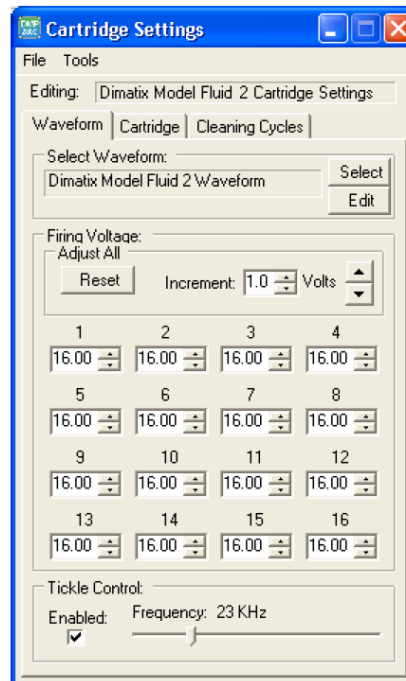
# Part 2 - How to use the DMP2831

- Compatible inks;
- Filling and installing a cartridge;
- How to unclog nozzles;
- Install the cartridge;
- Cartridge mounting angle;
- Calibrate the nozzles view;
- The Drop Watcher;
- **Designing a Waveform:**
  - Cartridge Settings;
  - The Waveform Editor;
  - Optimizing the waveform

# Cartridge Settings

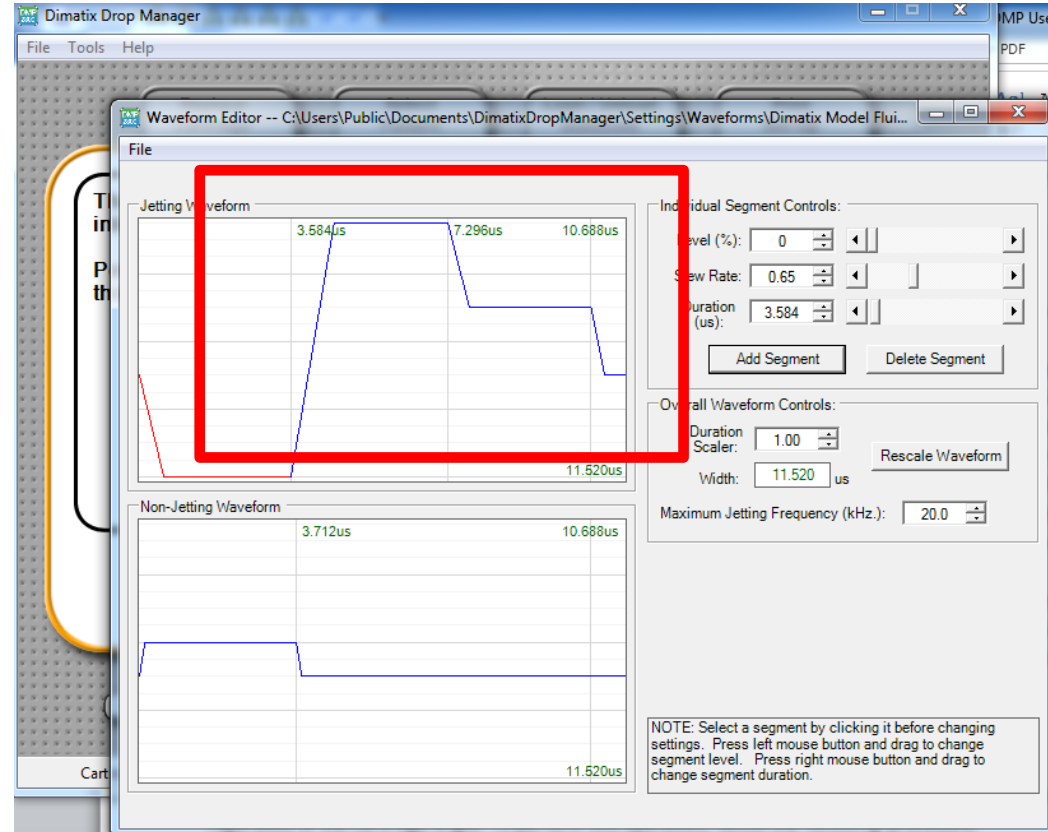
## Cartridge Settings:

- Waveform;
- Cartridge;
- Cleaning Cycles.



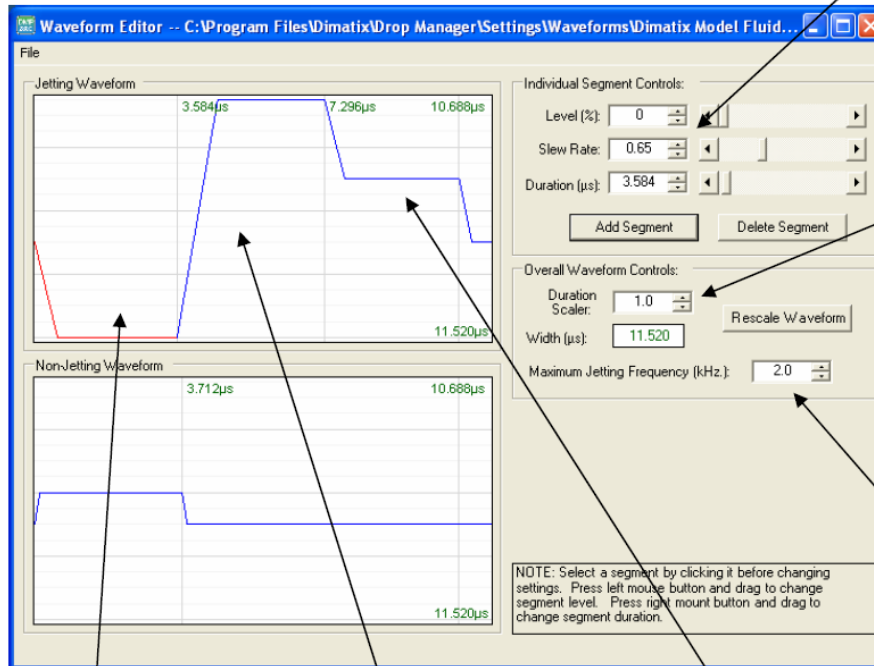
# The Waveform Editor

- Make sure the fluid meets the cartridge specification in terms of viscosity, surface tension, and density;
- This is the most powerful screen in the control software regarding jetting fluids.
- On this screen you control the shape of the pulse to the nozzle to eject a drop. To adjust a segment, simply point your arrow to it and click on it. The selected segment will change from blue to red.



# The Waveform Editor

## Waveform editor window explanation



These are the controls for making adjustments... Select the segment then use the controls. Watch the drops change velocity and shape on the screen. All adjustments are real time.

This is the overall pulse length, and is related to the speed of sound in your fluid. As a rule lower viscosity = shorter pulse... higher viscosity longer pulse. Use the duration scaler to go up and down (1.1 – 0.9)

You can limit the maximum jetting frequency for a particular fluid here.

This is the negative section that draws fluid into the pumping chamber. Followed by a hold / settling time

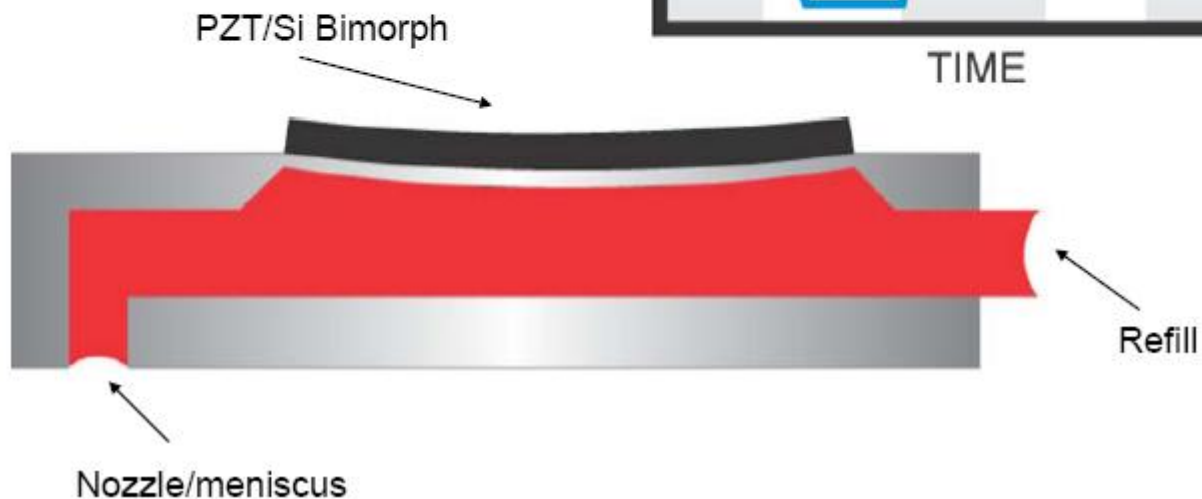
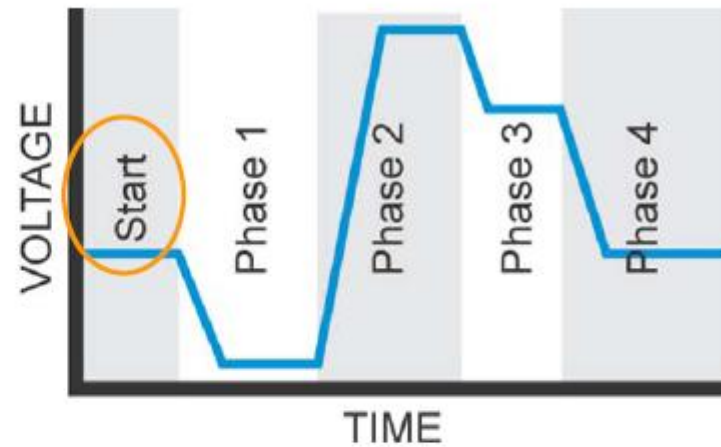
This is the firing pulse ... the steepness of the slope provides the energy for the initial ejection. It is followed by a hold period as well.

This is what is usually seen as the dampening segment and is designed to prevent the printed head from sucking air back in. This changes with different materials. This section brings the PZT back to a null position.

# The Waveform Editor

## Start (or Standby)

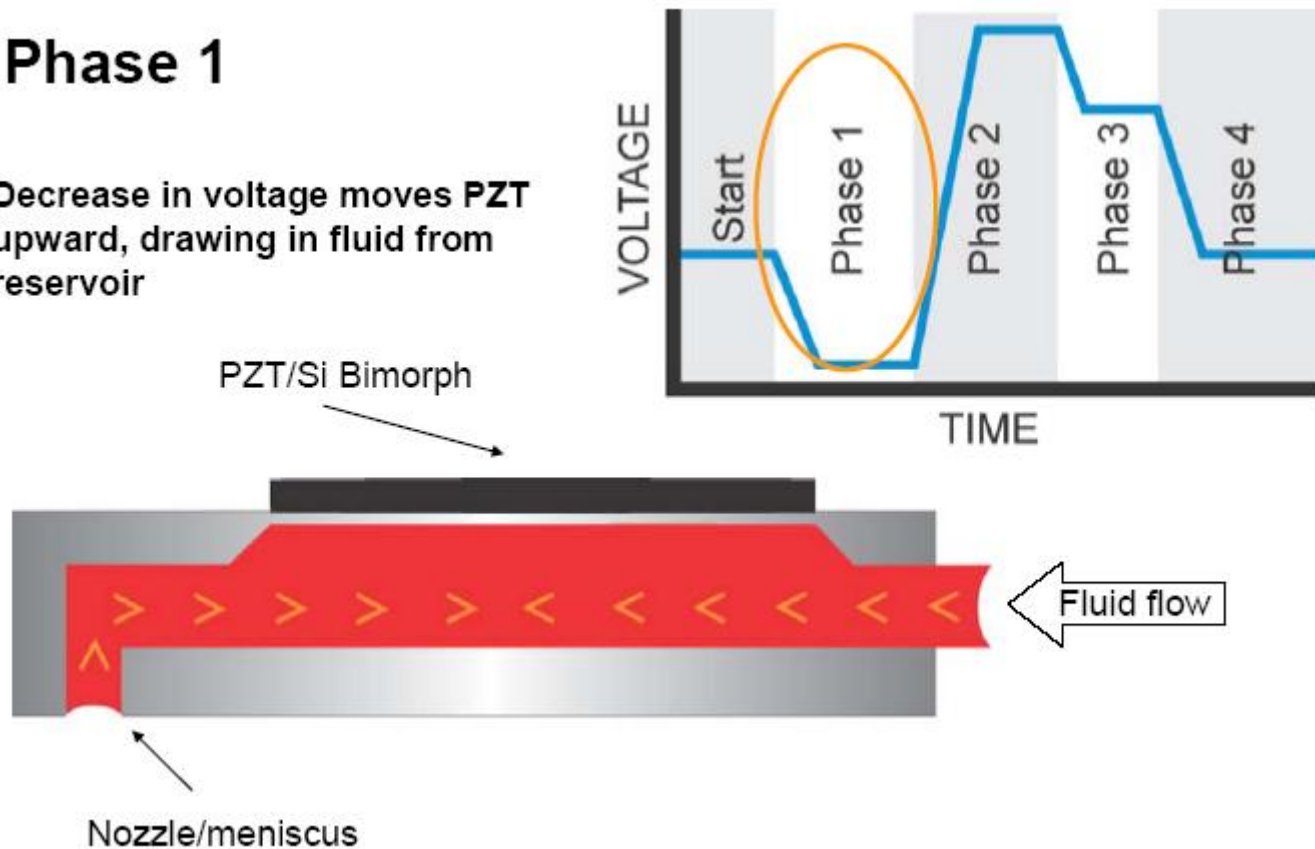
PZT bimorph is slightly deflected prior initiation of drive pulse train



# The Waveform Editor

## Phase 1

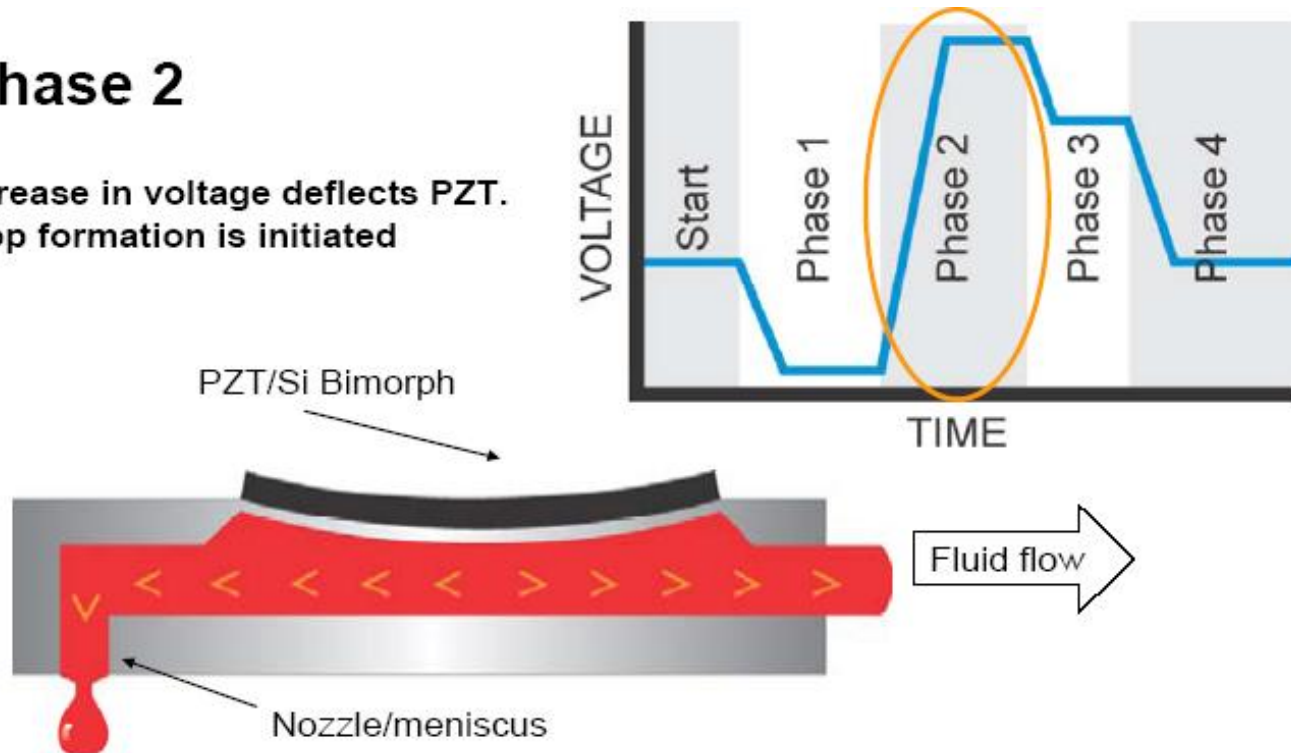
Decrease in voltage moves **PZT** upward, drawing in fluid from reservoir



# The Waveform Editor

## Phase 2

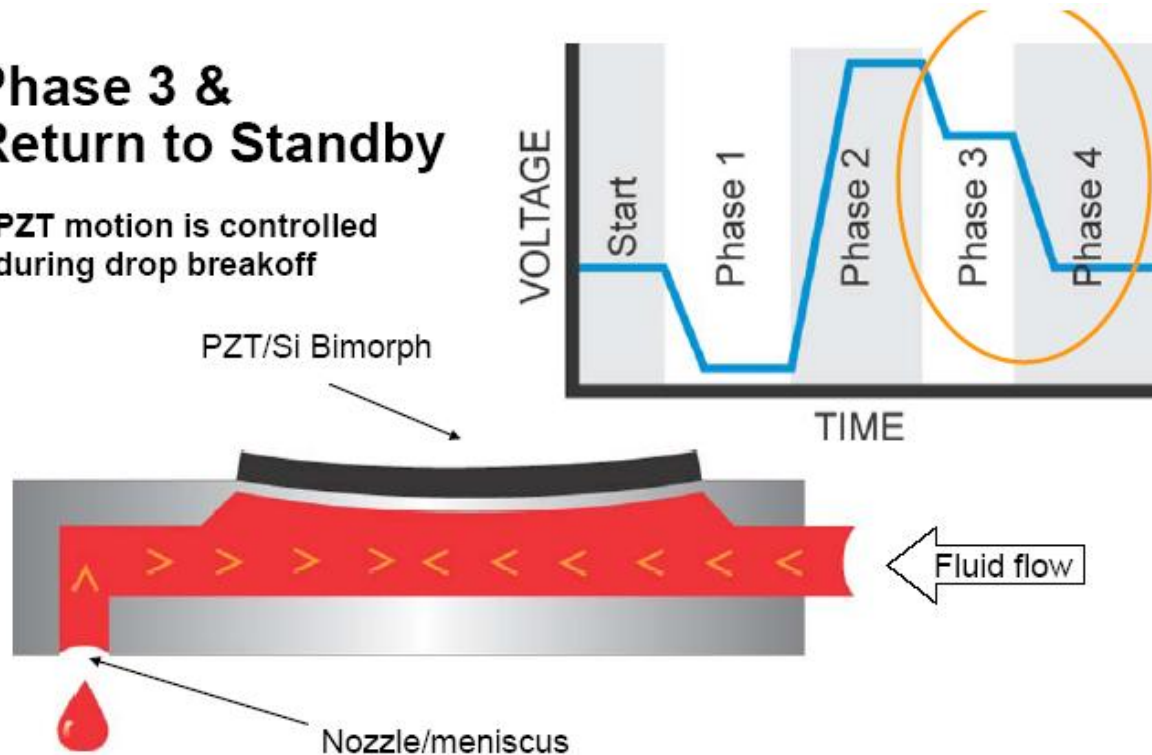
Increase in voltage deflects PZT.  
Drop formation is initiated



# The Waveform Editor

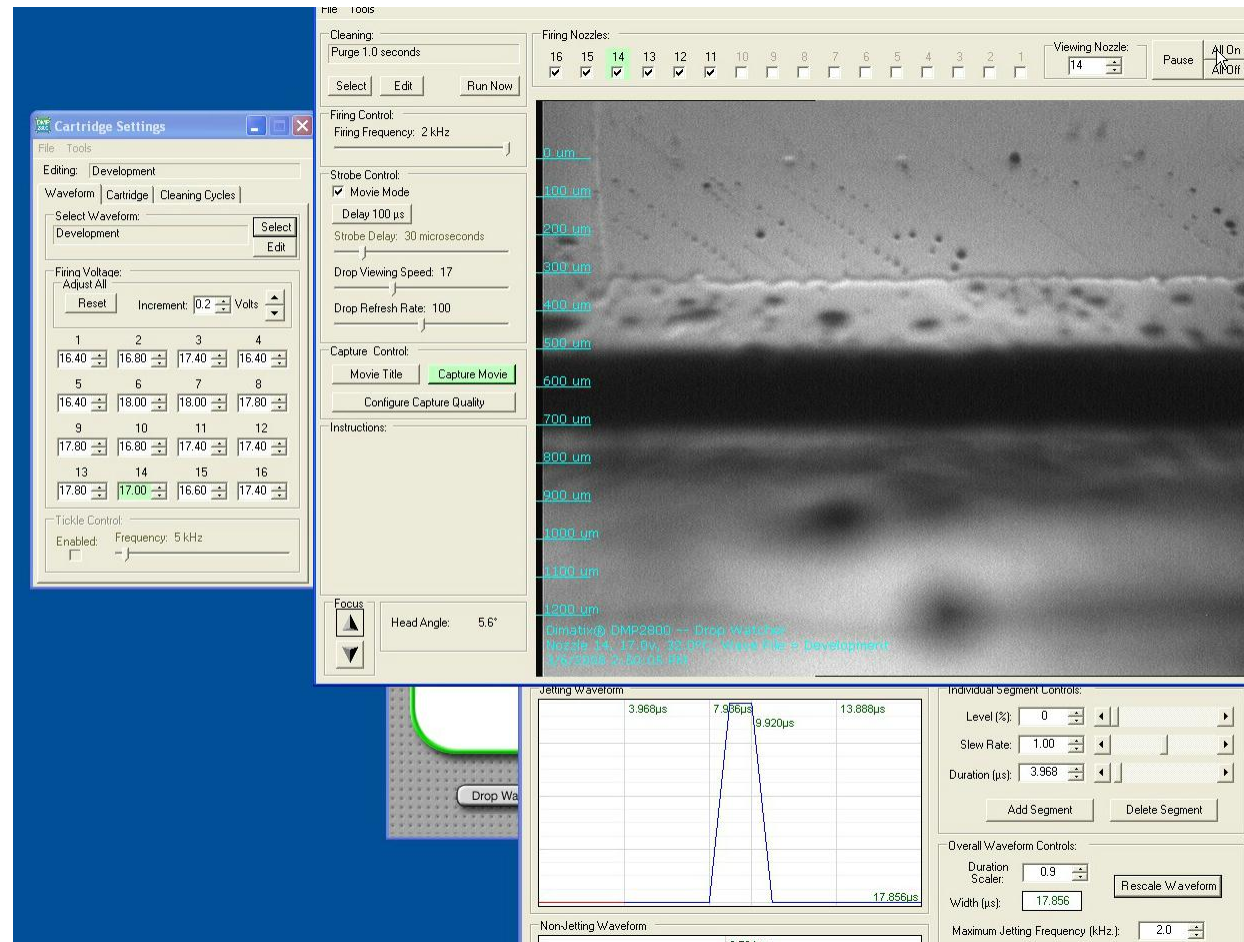
## Phase 3 & Return to Standby

PZT motion is controlled during drop breakoff



# Optimizing the Waveform

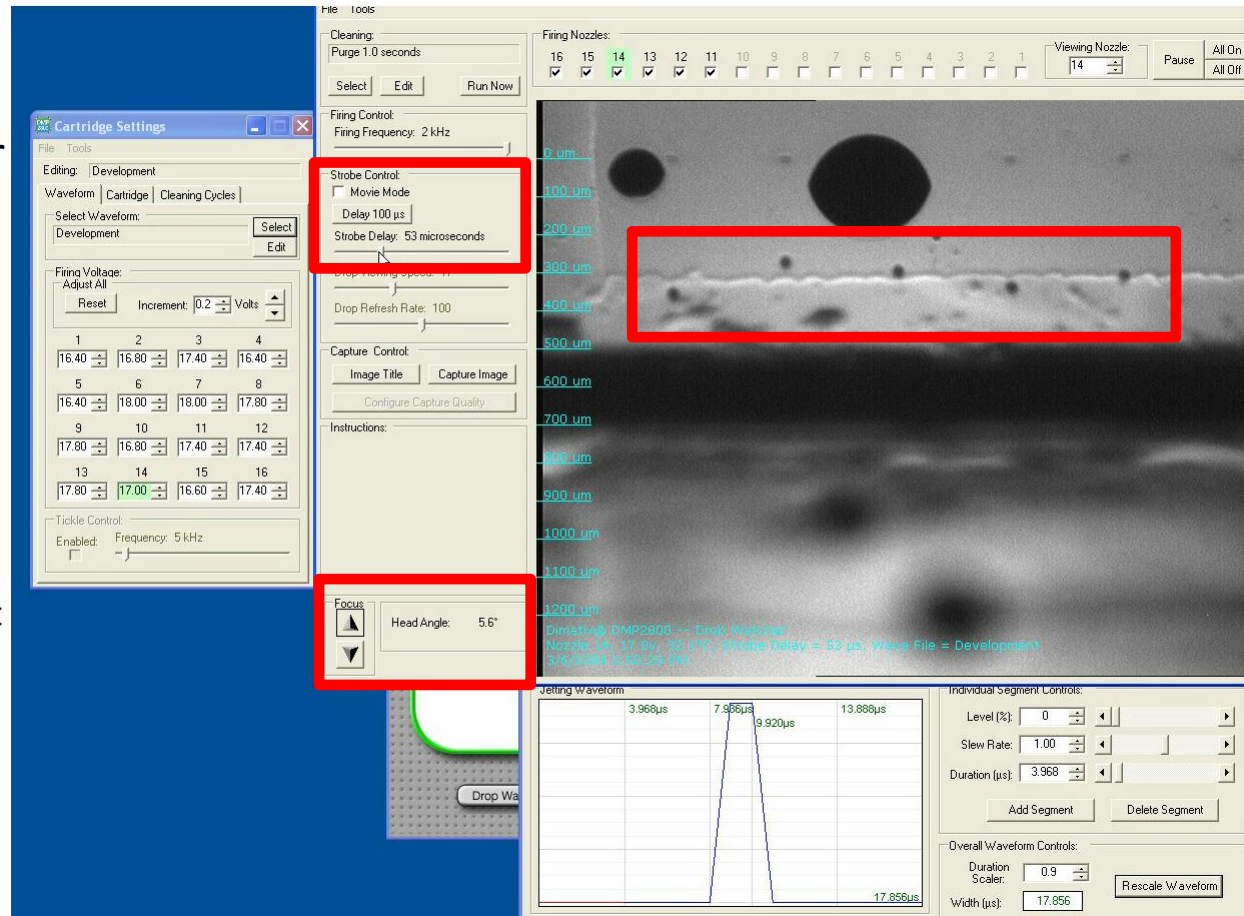
- Make sure your fluid meets the specifications for the cartridge;
- Open:
  - Drop watcher;
  - Cartridge settings;
  - Waveform Editor
- Right click on nozzle 14 e.g.:
  - The camera points on the nozzle 14;



# Optimizing the Waveform

- If the selected nozzles do not eject because the cartridge has been sitting for a while, **run a purge cycle**;
- Take the system out of movie mode by **deselecting 'Movie Mode'**;
- Change the strobe delay:
  - If a drop is at 300um from the nozzle and the strobe delay is 53 microseconds, it means that
  - **The drop speed is:**

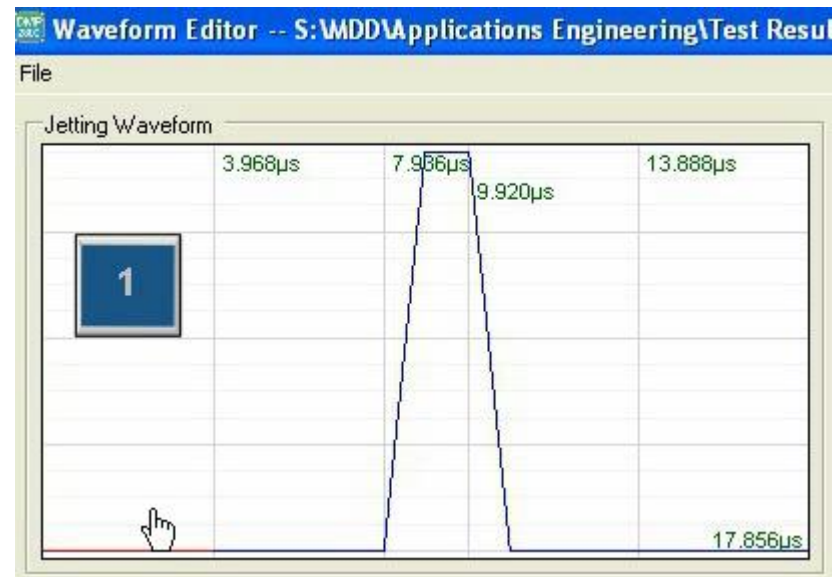
$$v_{drop} = \frac{Position}{Delay} = \frac{300}{53} \left[ \frac{m}{s} \right] = 5.3 \left[ \frac{m}{s} \right]$$



- Focus

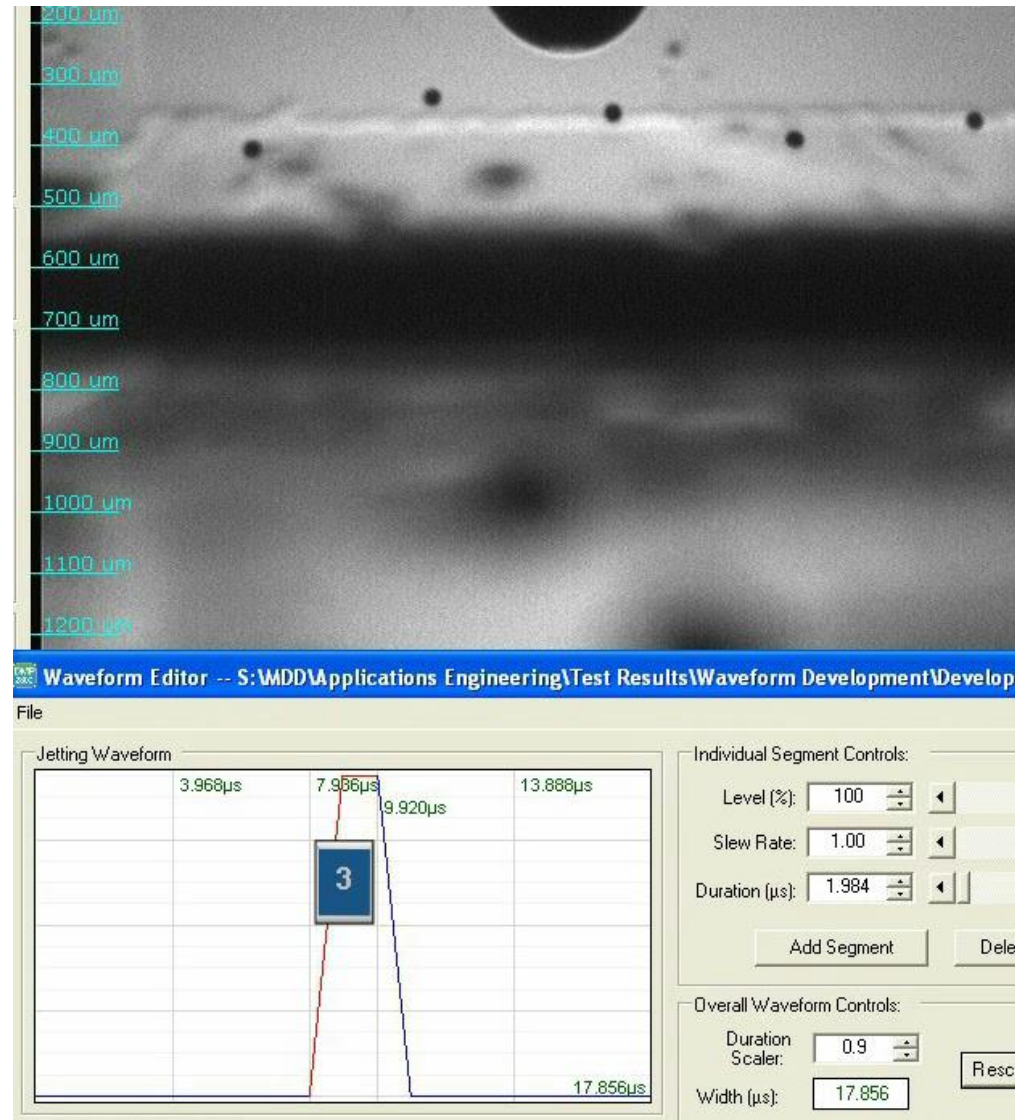
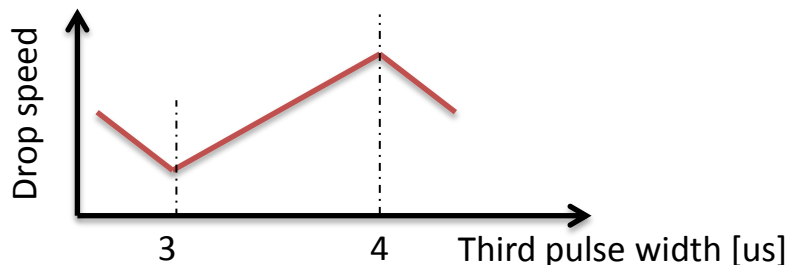
# Optimizing the Waveform

- Let's have a closer look at the jetting waveform;
- The present waveform is broken up into 5 segments;
- The idled nozzles get the waveform described by the non jetting waveform;
  - this might help preventing nozzles clogging;
- We need to develop the **base pulse** for the fluid;
- This is essentially tuning the driving pressure pulse to the acoustic properties of the fluid and the physical characteristics of the pumping chamber.



# Optimizing the Waveform

- Let's focus on the **third segment**.
- The goal is to produce **maximum velocity using minimum voltage**:
  - Drops should travel faster than 6 m/s;
  - The upper speed limit is about 10 m/s.
- As we change the **pulse width** there will be a change in the drop position.
- If the drop moves farther away from the nozzle this corresponds to an **increase in velocity**.
- If we increase the duration of segment 3, the velocity increases. This is good.
- If we keep increasing the duration there will be a point at which the drop, rather than increasing velocity, slows down. This happens at about 4  $\mu\text{s}$ ;
- The range of duration for which the increase in duration corresponds to an increase in the drop speed is between 3 and 4  $\mu\text{s}$ .
- **We now set all segments to 3  $\mu\text{s}$ .**

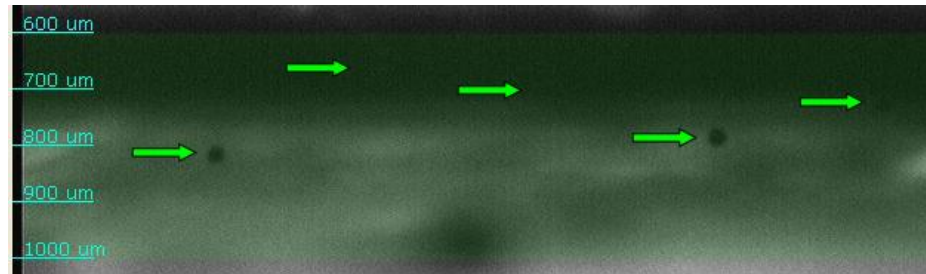
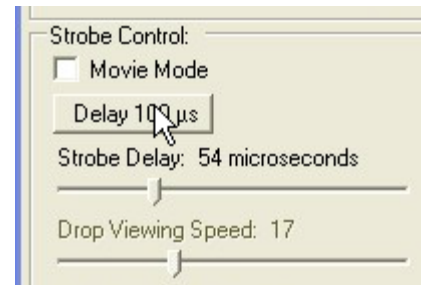


# Optimizing the Waveform

- The **delay 100 us** is very convenient because it allows rapidly calculating the drop speed

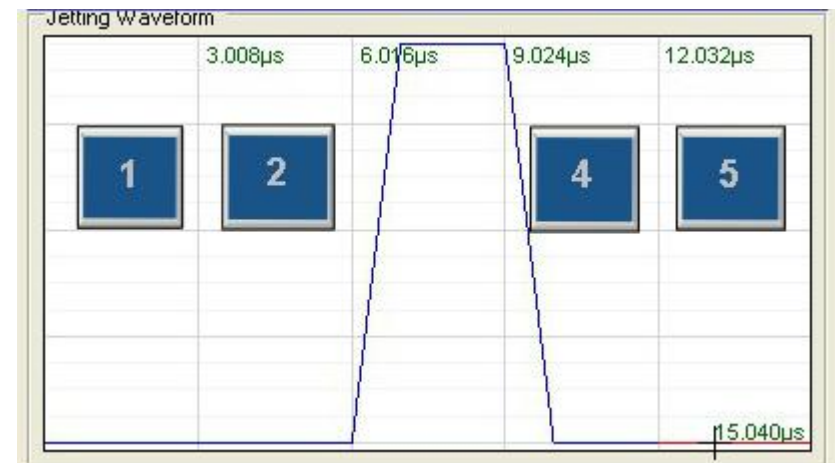
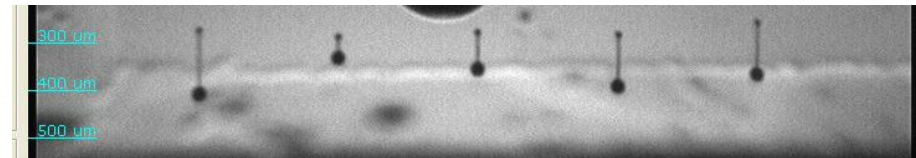
$$v_{drop} = \frac{Position}{100 \mu s} = \frac{300}{100} \left[ \frac{m}{s} \right] = 3 \left[ \frac{m}{s} \right]$$

- This means that the waveform should be adjusted so that drops are between the 600um and the 1000um line;
- Drops can be also moved by slightly increasing the voltage.



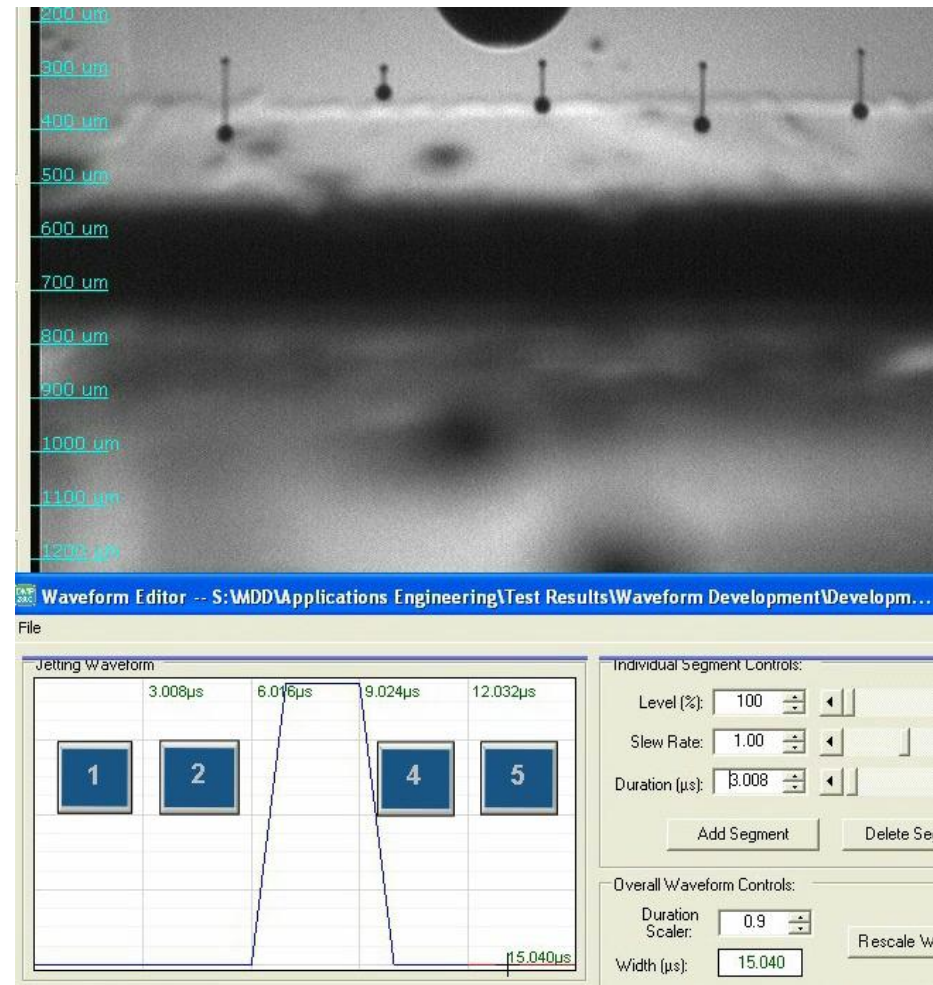
# Optimizing the Waveform

- By **reducing the strobe** delay we can check the drop formation at the nozzles;
  - Ligament, drop formation mechanics
- Now the objective is to **balance** the **drop formation** characteristics with the **drop velocities**;
- **How does a good drop look like?**
- Segments 4 and 5 will have more effect on the ligament;
- Segments 1 and 2 have more effect on the overall velocity of the main droplet.



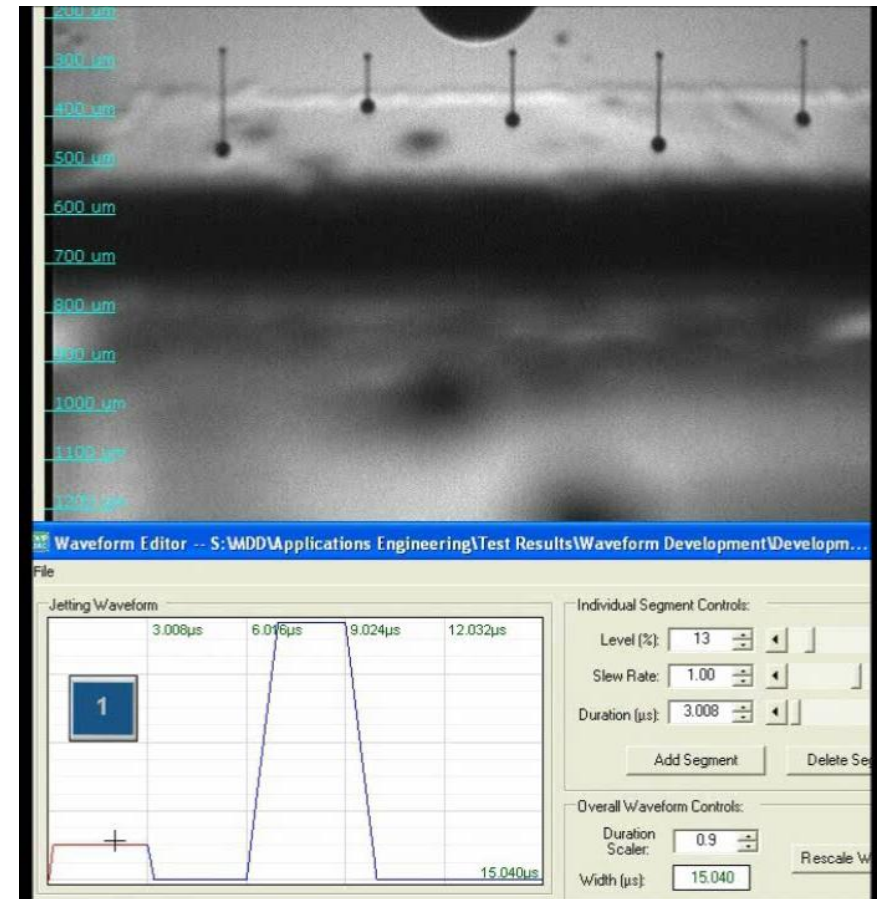
# Optimizing the Waveform

- By increasing Segment 5 amplitude:
  - The ligament becomes shorter (good);
  - The velocity reduces (bad);



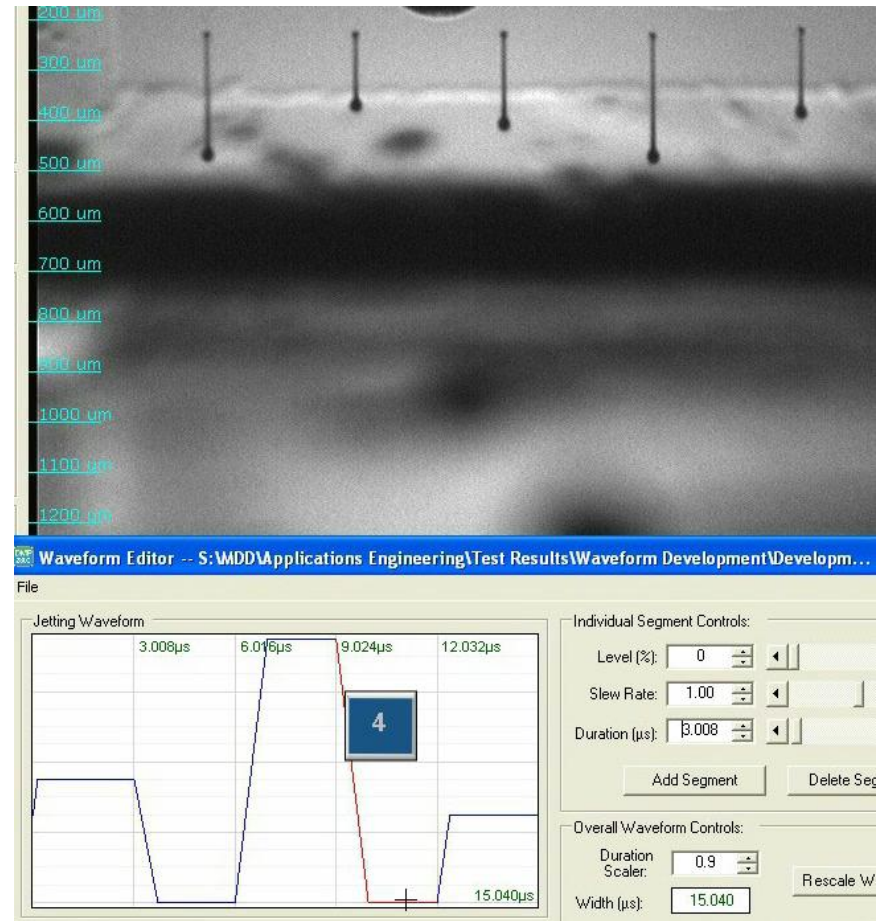
# Optimizing the Waveform

- By increasing Segment 1 amplitude:
  - The ligament becomes longer (bad);
  - The velocity increases;
- By further increasing the amplitude of Segment 1:
  - The ligament separates (satellite droplet) from the main drop, which is not desirable;
  - Satellites and main drop might have different velocities (bad)
  - However if we increase Segment 5, the ligament attaches again
- We need to play with both the amplitudes.



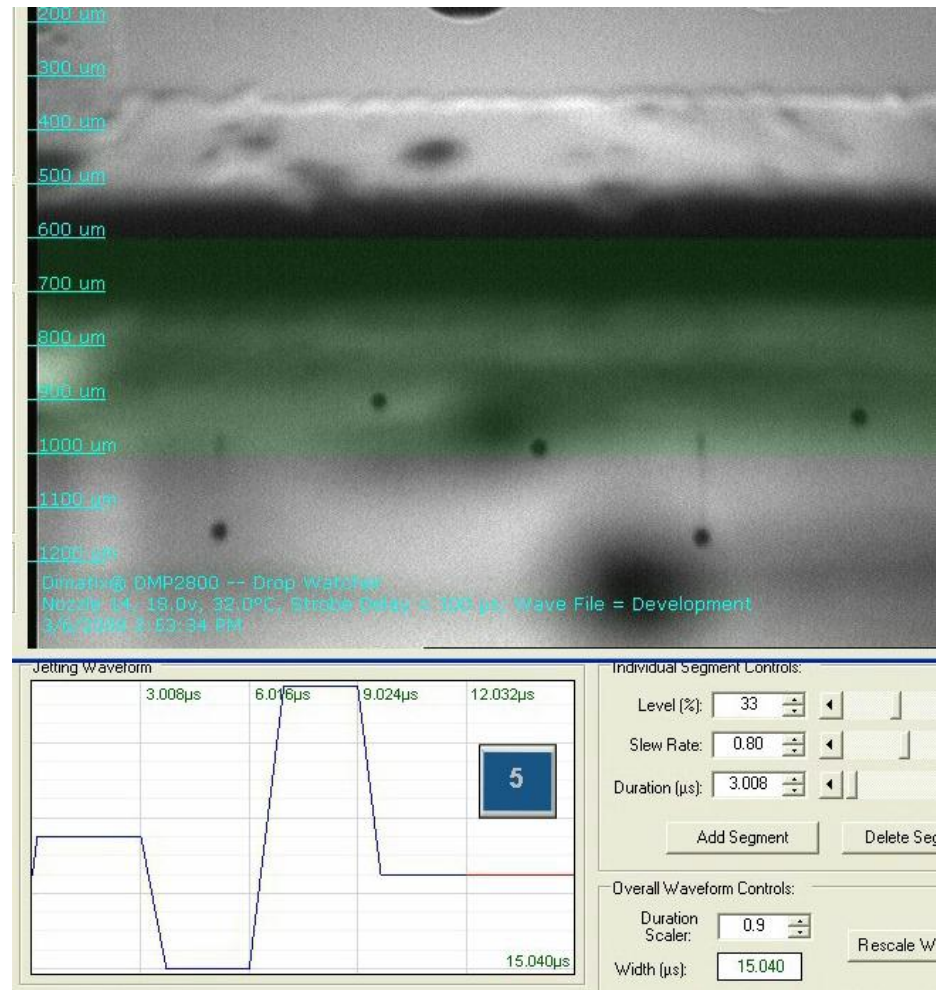
# Optimizing the Waveform

- Let's play with segment 4;
- Segment 4 does not impact the drop velocity, so we leave it at the same amplitude as segment 5;
- One of the objectives here is to design the simplest possible waveform.



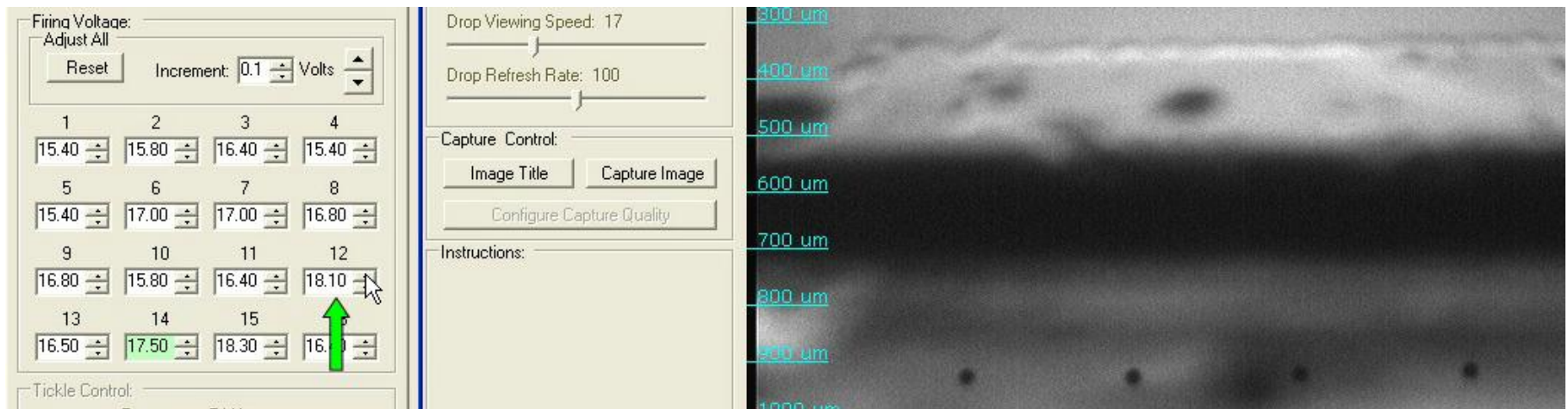
# Optimizing the Waveform

- If we set the strobe delay to 100us we can observe that the drops exceed the range of velocities 6-10 m/s:
  - Therefore we can reduce the voltage;
- We check again the drop formation;
- In order to make the waveform as simple as possible we can try to:
  - Delete Segment 5: this doesn't affect the drop formation nor the drop velocity;
  - Leave Segment 1 and 4 at the sample amplitude and play with their amplitude;
  - Delete Segment 1.



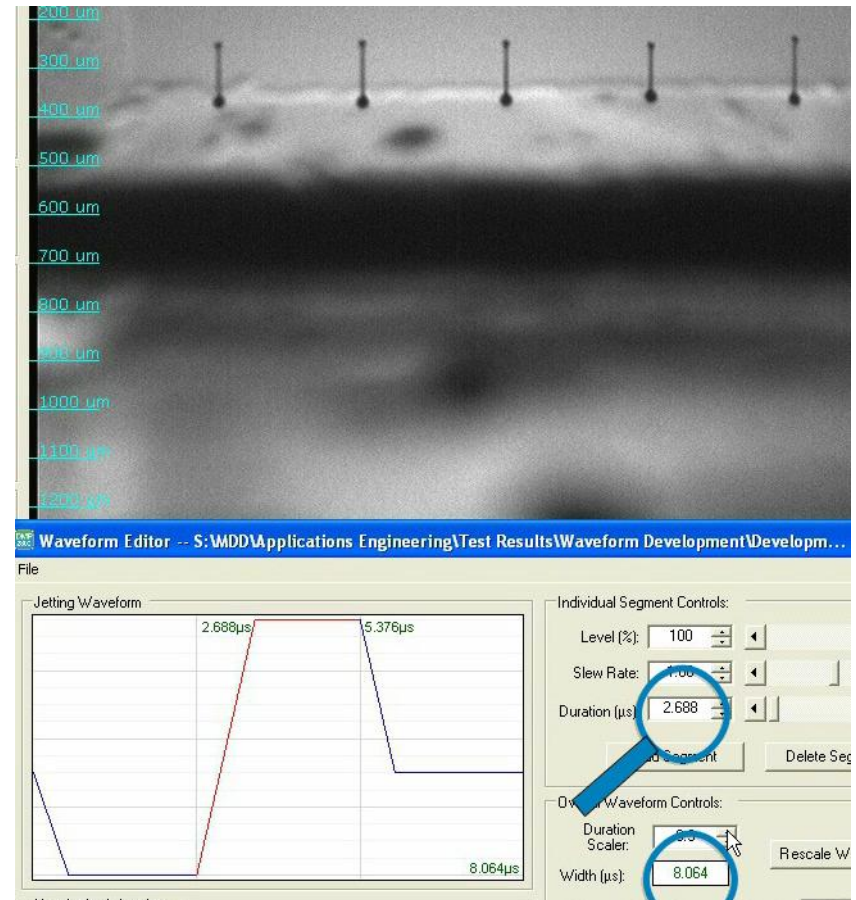
# Optimizing the Waveform

- Adjust the firing voltages for each nozzles so that all the drops have the same velocity



# Optimizing the Waveform

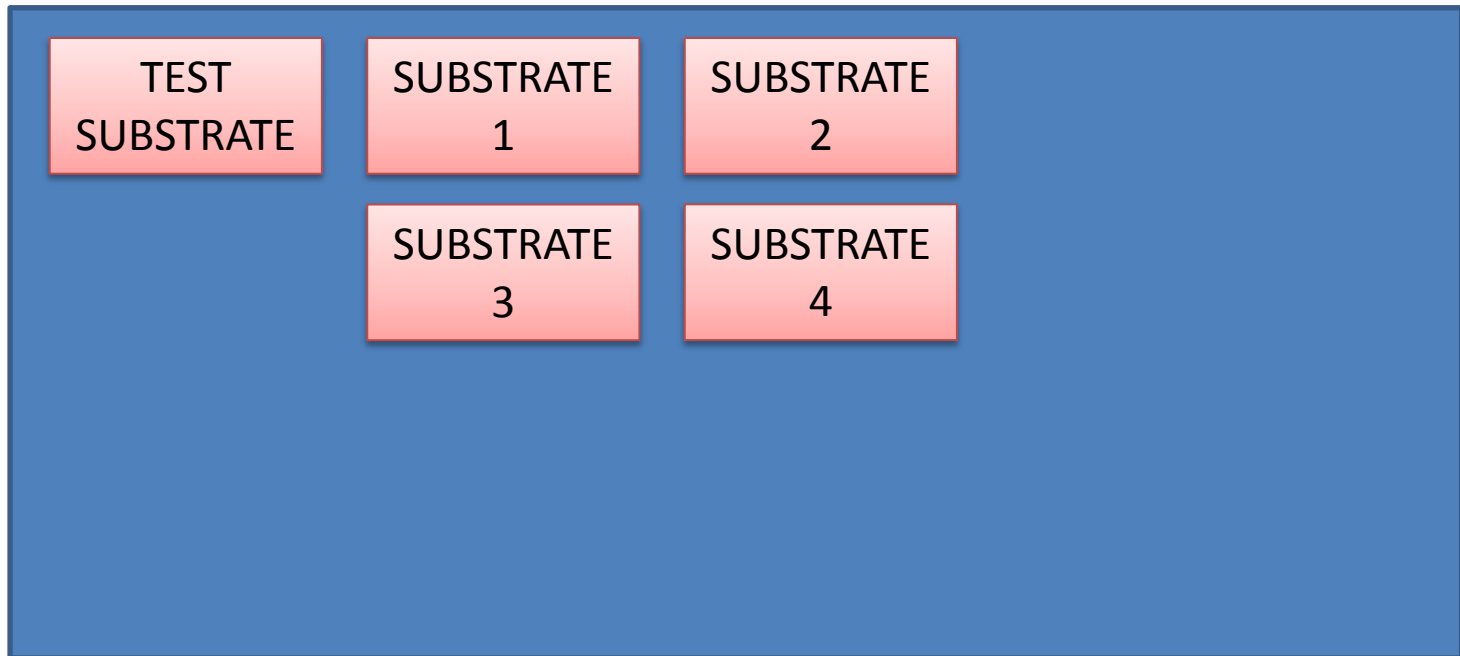
- Now that the drops look good, the waveform can be further optimized by using the 'Overall Waveform Control';
- Use only small changes for the duration scaler of 0.9 or 1.1;
- Save the Waveform file;
- Save the Jetting file.



# Part 3 - DMP2831 advanced controls

- **Organize the working area;**
- Is the Printer OK? Print Test
- Drop Diameter;
- Design your pattern:
  - Pattern Editor;
  - How to work with B/W bitmaps
- Cartridge mounting angle;
- Offset Adjustment;
- Print Test Pattern;
- Print

# Organize the working area



Keep the same X, Y gap between substrates

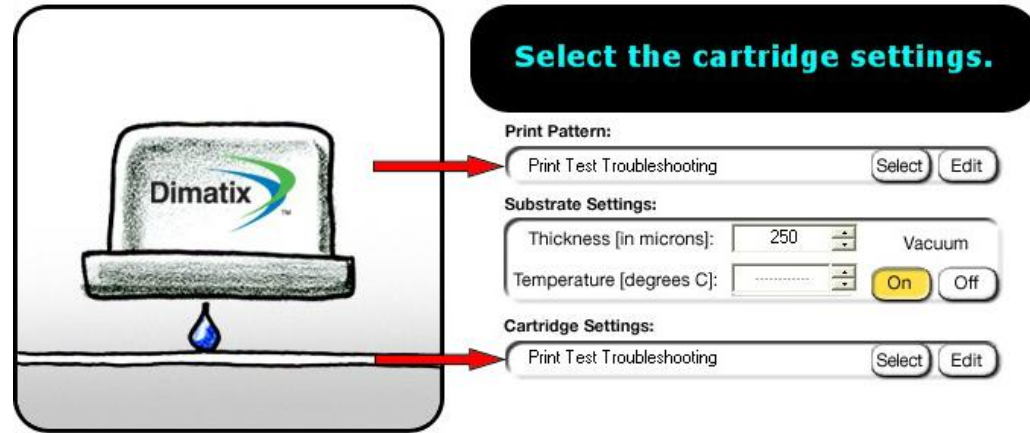
Use a metal supporting mask (i.e. the one used for metal evaporation)

# Part 3 - DMP2831 advanced controls

- Organize the working area;
- **Is the Printer OK? Print Test;**
- Drop Diameter;
- Design your pattern:
  - Pattern Editor;
  - How to work with B/W bitmaps
- Cartridge mounting angle;
- Offset Adjustment;
- Print Test Pattern;
- Print

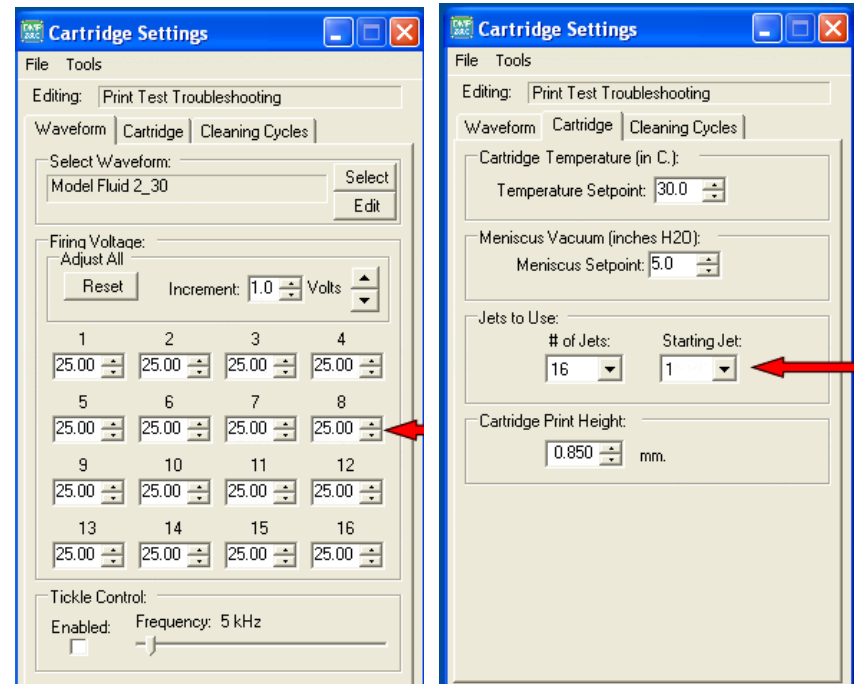
# Is the Printer OK? Print Test

- Model Fluid;
- 10pL cartridge;
- Fill the cartridge;
- Install the cartridge on the printer and wait for 30 min;
- Run a purge cycle (2sec)
- Print Pattern: 'Print Test Troubleshooting'
- Cartridge Settings: 'Print Test Troubleshooting'



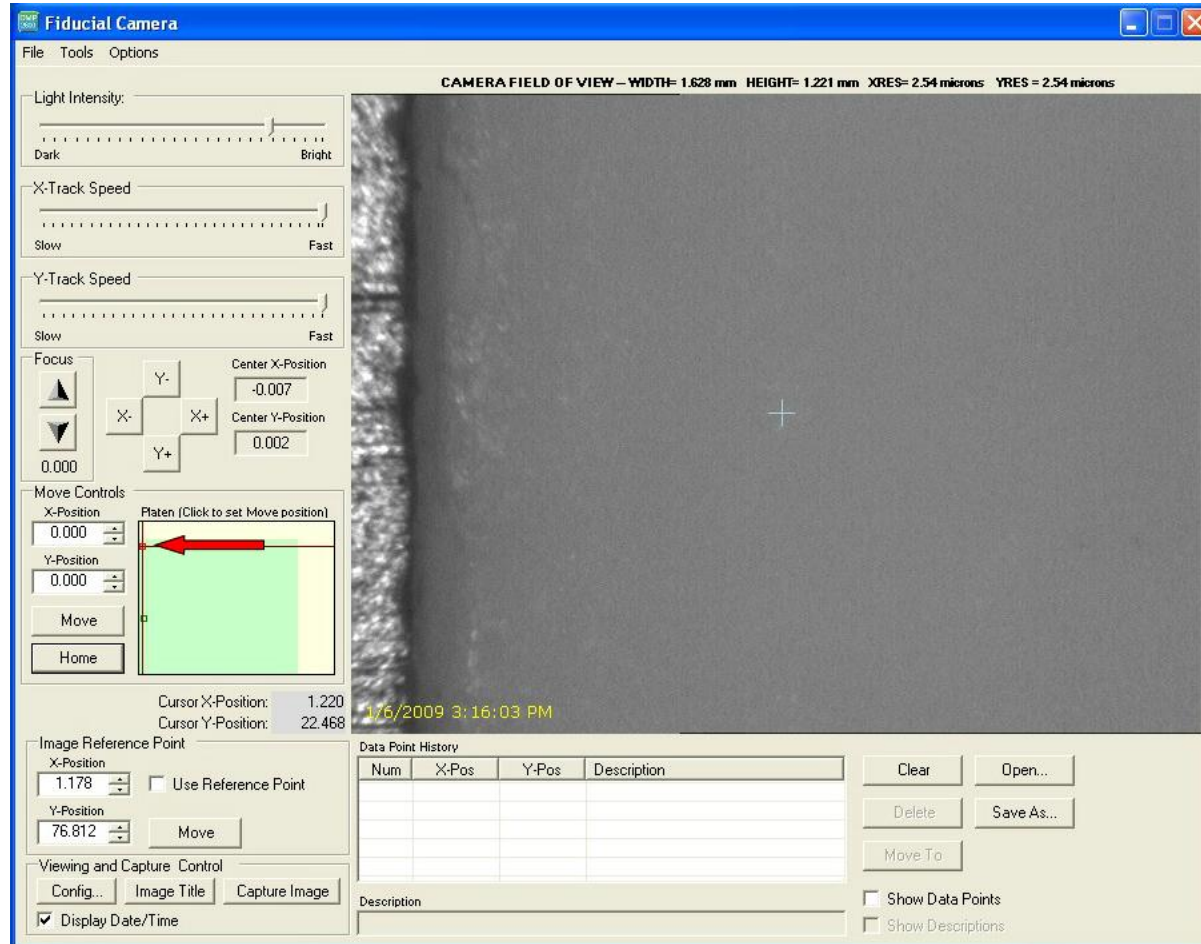
# Print Test

- Open Cartridge Settings;
- All nozzles: 25V, enabled
- Cleaning cycle: purge 2 seconds
- Load a piece of paper.



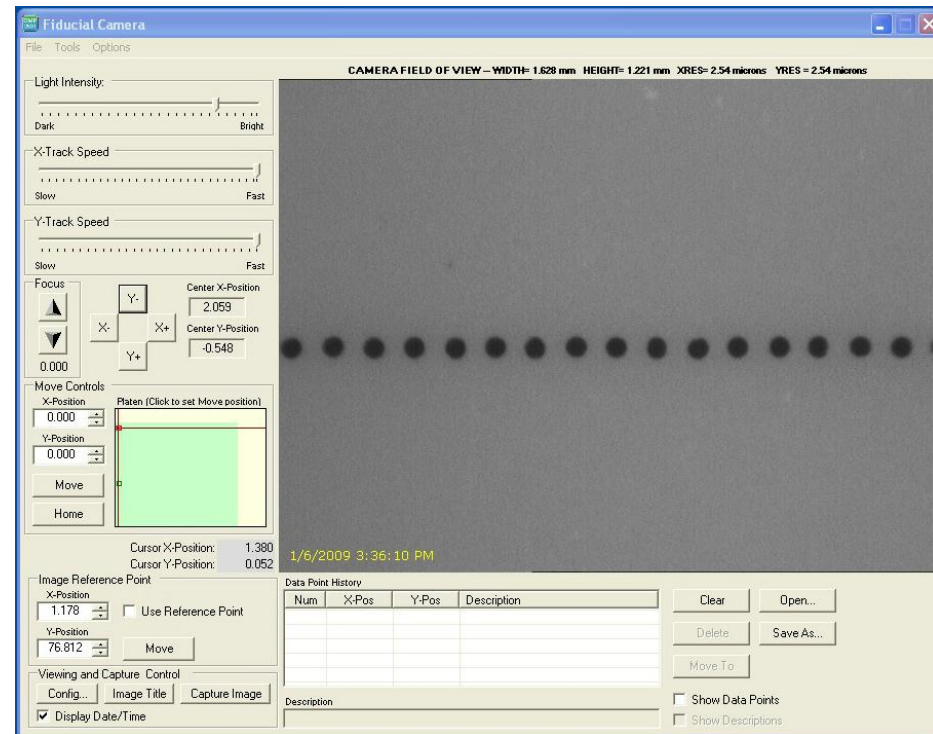
# Print Test

- The print pattern will take most of the paper, therefore the origin should be set at the left-hand side of the paper;
- Set the print head at  $22.3^\circ$
- Print



# Print Test

- With the Fiducial Camera visually inspect the printed pattern
- Each nozzles performance can be evaluated (in this case the 14<sup>th</sup> didn't work)
- All of the lines should be straight and consistent;
- Unconsistent lines are usually related to the fluid and not to the hardware

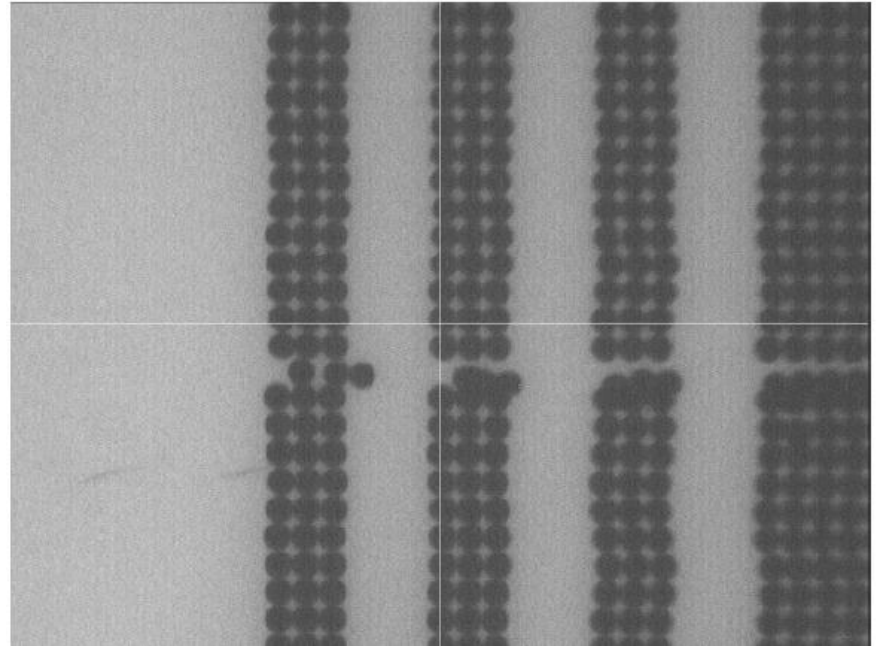


# Part 3 - DMP2831 advanced controls

- Organize the working area;
- Is the Printer OK? Print Test
- **Drop Diameter;**
- Design your pattern:
  - Pattern Editor;
  - How to work with B/W bitmaps
- Cartridge mounting angle;
- Offset Adjustment;
- Print Test Pattern;
- Print

# Drop Diameter

- Use the Fiducial Camera;
- Use a profilometer;
- (DO NOT USE AFM)



# Part 3 - DMP2831 advanced controls

- Organize the working area;
- Is the Printer OK? Print Test
- Drop Diameter;
- **Design your pattern:**
  - Pattern Editor;
  - How to work with B/W bitmaps
- Cartridge mounting angle;
- Offset Adjustment;
- Print Test Pattern;
- Print

# Pattern To Print

The screenshot shows the 'Pattern Editor' window with the following sections and values:

- Substrate Dimensions:**
  - X Width (mm): 115.020
  - Y Height (mm): 88.020
- Leader Bar:**
  - Width (mm): 2.000
  - Gap (mm): 5.000
  - ☒ Enable
- Drop Spacing:**
  - Microins: 20
- Layers:**
  - Count: 1
  - Interlayer Delay (sec.): 0
- Pattern Block Array:**
  - X Start (mm): 10.000, X Width (mm): 50.000, X Pitch (mm): 55.000, X Count: 2
  - Y Start (mm): 5.000, Y Height (mm): 40.000, Y Pitch (mm): 43.000, Y Count: 2
- Pattern Block Drop Positions:**
  - X Start (mm): 35.000, X Width (mm): 3.000, X Count: 151, Increment Value: 5.000
  - Y Start (mm): 20.000, Y Height (mm): 10.000, Y Count: 501, Drop Area Count: 75651
- Drop Position Table:**

X Start	Y Start	X Width	Y Height	X Count	Y Count
10.000	10.000	10.000	3.000	501	151
35.000	20.000	3.000	10.000	151	501

**Annotations:**

- Minimum substrate size to fit the whole pattern (points to Substrate Dimensions)
- Leader bar width (points to Leader Bar Width)
- Gap between leader bar and print pattern (points to Leader Bar Gap)
- Center to center drop distance for neighboring drops for the entire file (points to Drop Spacing)
- Number of repetitions of this pattern and pause in between repetitions (points to Layers Count)
- Distance between copies of pattern block arrays (points to Pattern Block Array X Pitch)
- Number of copies in x and y direction (points to Pattern Block Array X Count and Y Count)
- Pattern block array offset (points to Pattern Block Array X Start and Y Start)
- Pattern block array size (points to Pattern Block Array X Width and Y Height)
- Values for rectangle 1 ( $x_{start1}$ ,  $y_{start1}$ ,  $x_{width1}$ ,  $y_{height1}$ ) (points to first row of Pattern Block Drop Positions)
- Values for rectangle 2 ( $x_{start2}$ ,  $y_{start2}$ ,  $x_{width2}$ ,  $y_{height2}$ ) (points to second row of Pattern Block Drop Positions)
- Total number of drops for the highlighted rectangle (points to Drop Area Count)
- Number of drops in x and y direction for this rows rectangle (points to X Count and Y Count in the table)

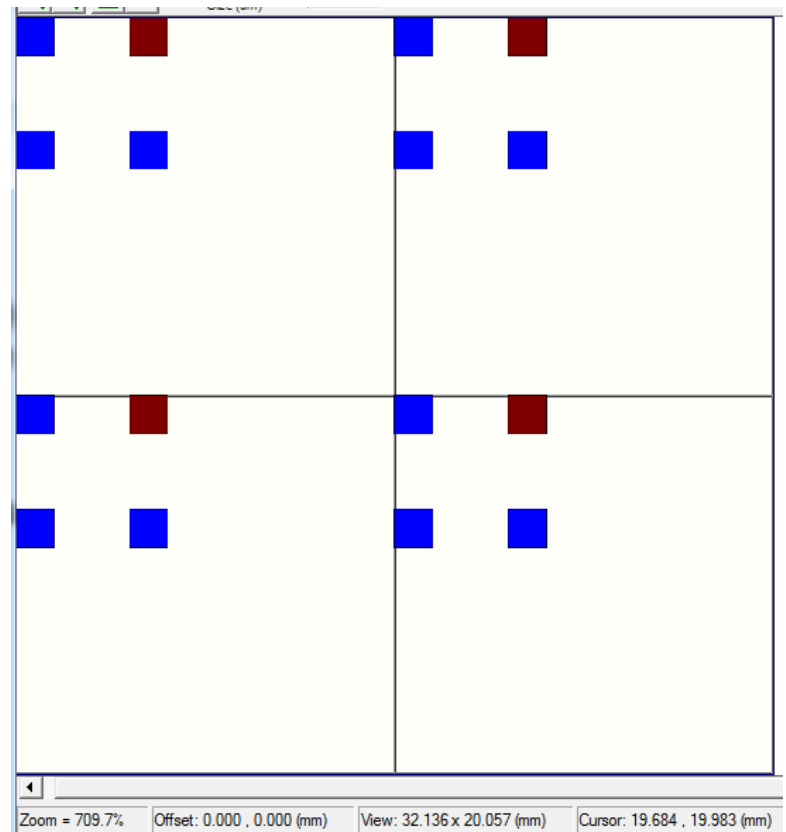
# Pattern To Print

- Dimatix Pattern Editor

- Substrate:

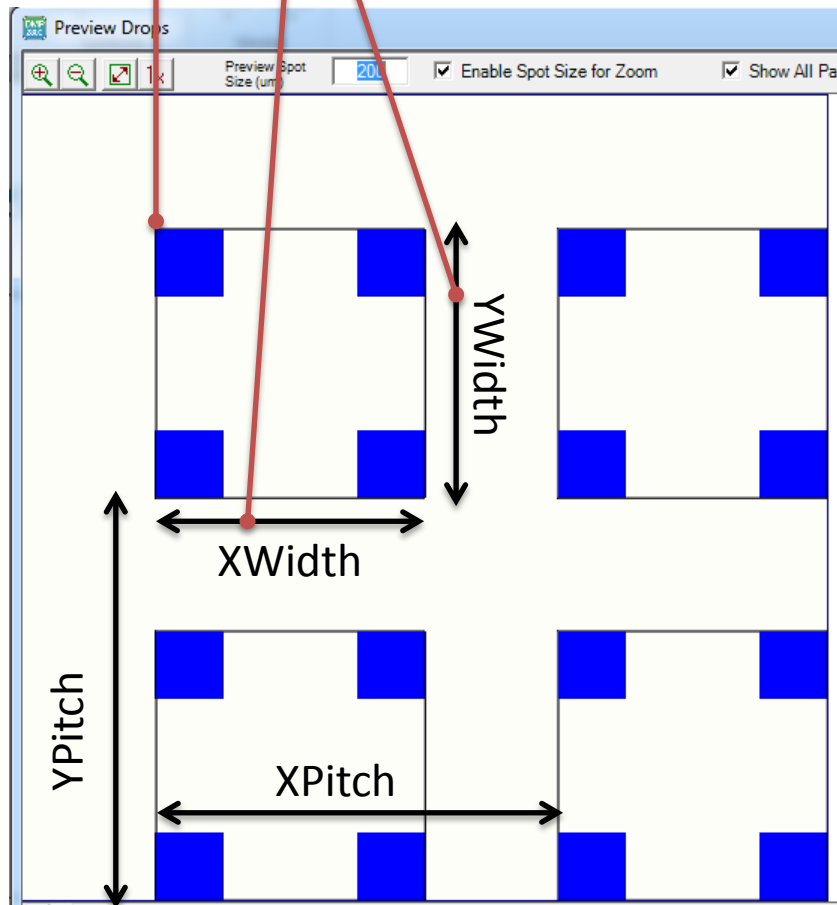
- Dimensions:
  - automatically calculated;
  - total pattern dimension.
- Leader Bar:
  - Vertical bar that can be jetted (by checking the **Enable** box) which will precede your pattern. This is often used to “pre-fire” nozzles to keep them active and their drop velocity uniform to improve pattern quality. The **Width** of it and the **Gap** of the Leader Bar can be entered in the boxes.
- Drop Spacing: **fundamental**
  - center to center distance from one drop to the next in X and Y position
- Layers:
  - Reprint the same pattern several times (thickness control)

The screenshot shows the 'File' menu at the top. Below it, the 'Substrate' section contains four panels: 'Dimensions' with 'X Width (mm)' at 20.020 and 'Y Height (mm)' at 20.020; 'Leader Bar' with 'Width (mm)' at 1.000, 'Gap (mm)' at 1.000, and an 'Enable' checkbox; 'Drop Spacing' with 'um (1270 DPI)' at 20; and 'Layers' with 'Count' at 1 and 'Interlayer Delay (sec.)' at 0.



# Pattern To Print

Pattern Array	
X Start (mm)	0.000
Y Start (mm)	0.000
X Width (mm)	4.000
Y Height (mm)	4.000
X Pitch (mm)	6.000
Y Pitch (mm)	6.000
X Count	2
Y Count	2



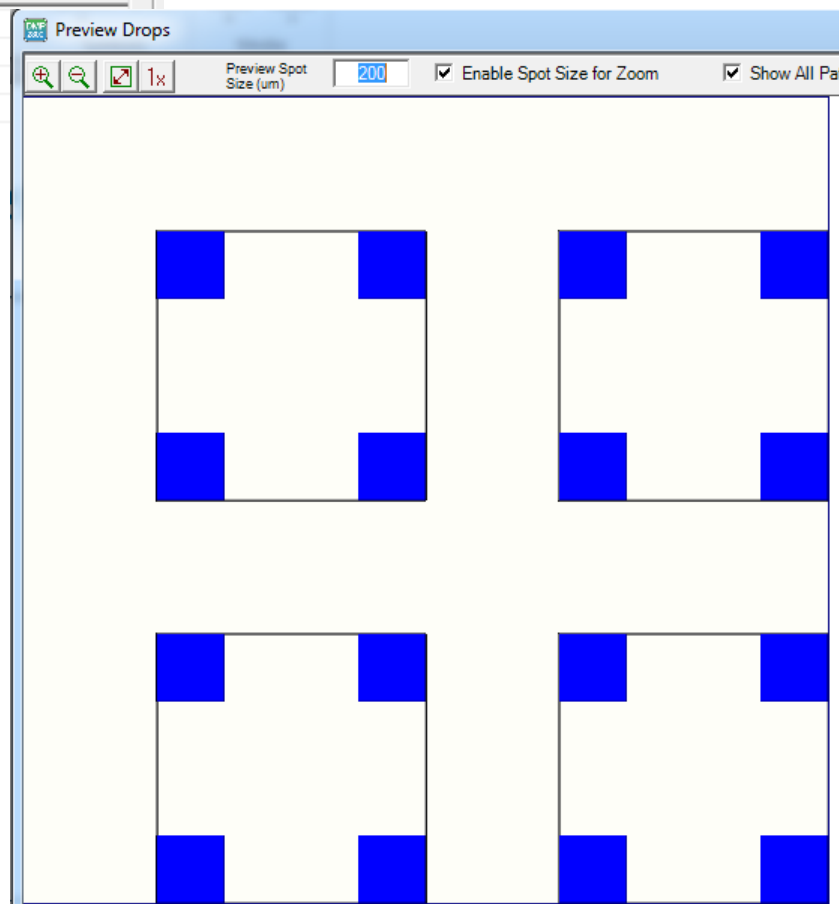
X Pitch (mm)	6.000
Y Pitch (mm)	6.000
X Count	2
Y Count	2

# Pattern to Print

Drop Position Array

X Start (mm)	X Width (mm)	X Count	Increment Value	Preview Drops
3.000	1.000	51	10.000	
Y Start (mm)	Y Height (mm)	Y Count	Drop Area Count	Add
0.000	1.000	51	2601	Delete

X Start	Y Start	X Width	Y Height	X Count	Y Count
0.000	0.000	1.000	1.000	51	51
0.000	3.000	1.000	1.000	51	51
3.000	0.000	1.000	1.000	51	51
3.000	3.000	1.000	1.000	51	51



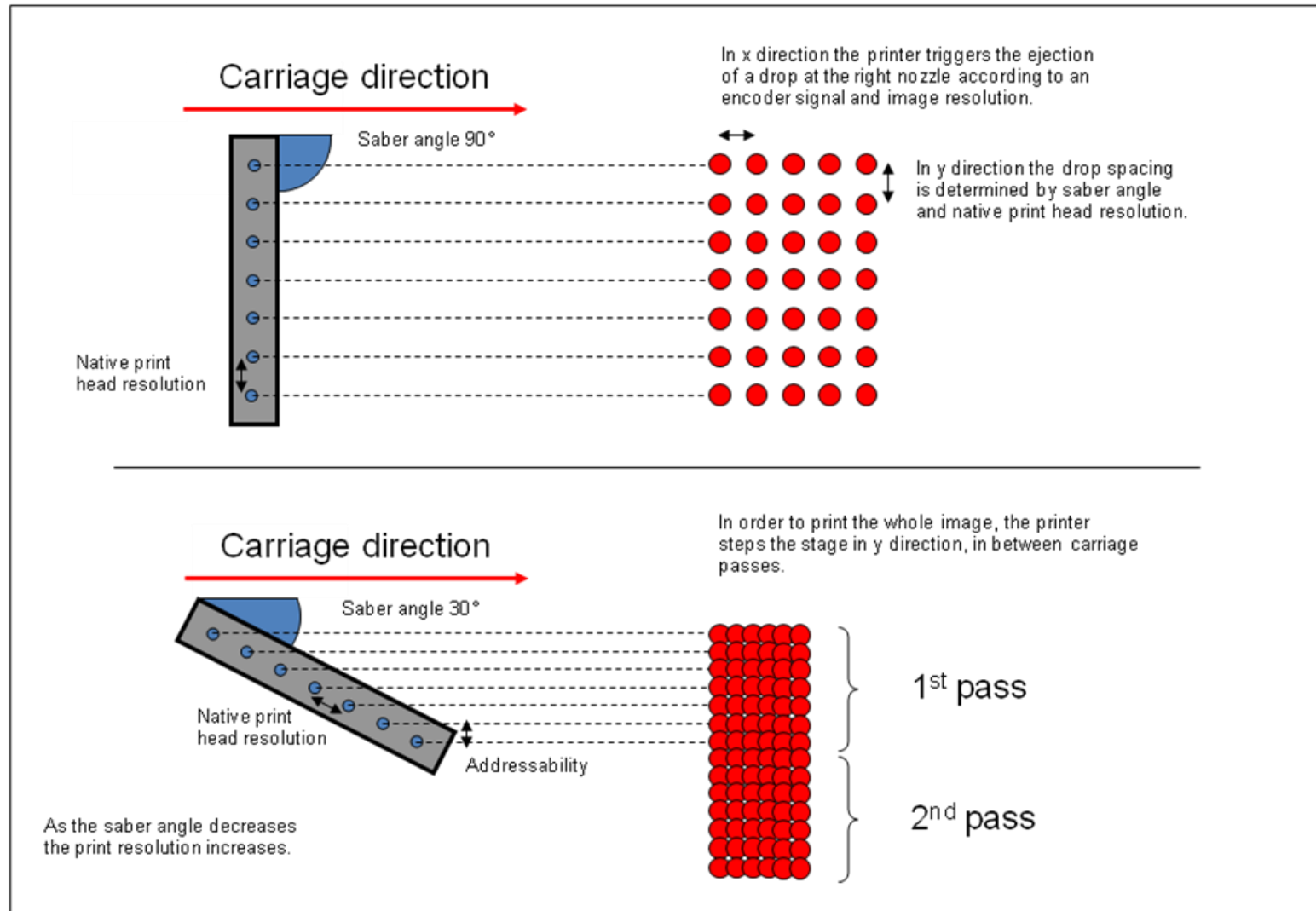
# Part 3 - DMP2831 advanced controls

- Organize the working area;
- Is the Printer OK? Print Test
- Drop Diameter;
- Design your pattern:
  - Pattern Editor;
  - How to work with B/W bitmaps
- **Cartridge mounting angle;**
- Offset Adjustment;
- Print Test Pattern;
- Print

# Cartridge mounting angle

- The Drop Spacing is the distance in X and Y, center to center, of the drops that the DMP will deposit to create the pattern;
- Drop Spacing is adjustable between **5 and 254 microns** in one micron increments;
- The Drop Spacing therefore determines your resolution or density in the X direction and determines the angle at which the cartridge must be set to get the same resolution or density in the Y direction.

# Calculate the mounting angle

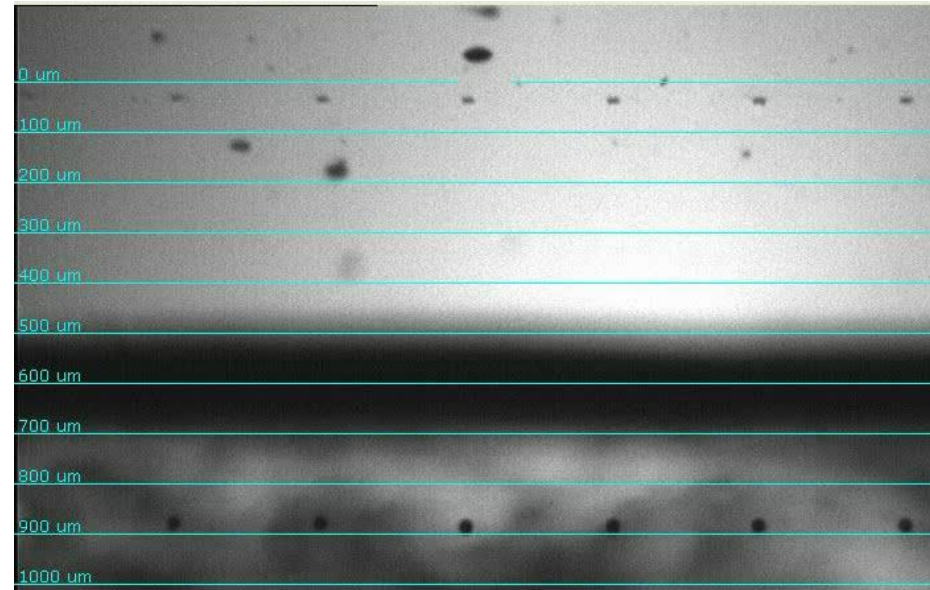


# Part 3 - DMP2831 advanced controls

- Organize the working area;
- Is the Printer OK? Print Test
- Drop Diameter;
- Design your pattern:
  - Pattern Editor;
  - How to work with B/W bitmaps
- Cartridge mounting angle;
- **Offset Adjustment;**
- Print Test Pattern;
- Print

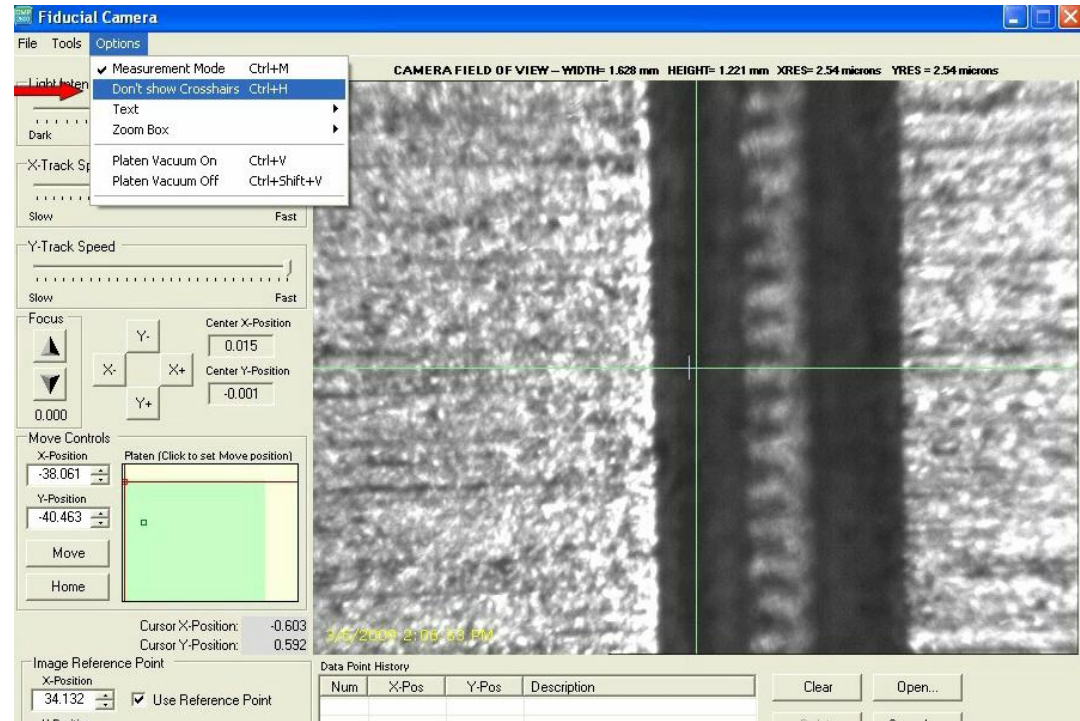
# Drop Offset Routine

- **This procedure has to be performed** every time:
  - the **print head is removed**;
  - the **print head angle** has changed
- In order for the Drop Offset routine to be accurate, the print head must already be adjusted or setup, meaning that the drop velocities for the nozzles have been adjusted;
- Open the Drop Watcher and make sure the drops have the right velocity and that they are aligned



# Drop Offset Routine

- Open the Fiducial Camera;
- Option -> Don't show Crosshairs;
- Set a new print origin on the substrate (or a test substrate):
  - This can be done with the Platen map
  - The small red box is the current carriage position;
  - The small green box is the current reference point;
  - The small grey box is position the carriage will move to, when the Move button is selected;
  - The red crosshair is the current print origin
- If you press Move the carriage will move to the grey box;
- The Drop Offset routine will print a 16x1 mm line on the substrate. At the end of the line there is a single drop which is the calibration drop
  - the line is just a reference point;
  - The line is usually above the camera position.
- Tools -> Set Drop Offset
- Follow the instructions
- If you cannot find the small drop DO NOT GUESS : try again!



# Further checks before printing

- Make sure all selected nozzles are working;
- Print a test pattern in the test sample.